12/8/2010 12:19 PM

Report of Sub-Committee 1 on Rajiv Awas Yojana

Guidelines for GIS Mapping, MIS development and Integration of GIS with MIS

MINISTRY OF HOUSING AND URBAN POVERTY ALLEVIATION

Table of Contents

Acronyms

APSRAC	Andhra Pradesh State Remote Sensing Applications Centre
CAD	Computer Aided Design
CEPT	Centre for Environmental Planning and Technology
CGG	Centre for Good Governance
DEM	Digital Elevation Model
DPRs	Detailed Project Reports
GIS	Geographical Information Systems
GPR	Ground Penetrating Radar
GPS	Global Positioning System
IFB	Invitation For Bid
ISRO	Indian Space Research Organisation
MEPMA	Mission for Elimination of Poverty in Municipal Areas
MIS	Management Information Systems
MoHUPA	Ministry of Housing and Urban Poverty Alleviation
MRSAC	Maharashtra Remote Sensing Applications Centre
NBO	National Building Organization
NIC	National Informatics Centre
NRSC	National Remote Sensing Centre
NSDI	National Spatial Data Infrastructure
NUIS	National Urban Information System
POA	Plan of Action
RAY	Rajiv Awas Yojana
RfP	Request for Proposal
RSACs	Remote Sensing Applications Centre
SOI	Survey of India
SRSAC	State Remote Sensing Application Centre
TBM	Temporary Bench Mark
TC	Technical Consultant
ToR	Terms of Reference
ULB	Urban Local Body
UTM	Universal Transverse Mercator
YASHADA	Yashwantrao Chavan Academy of Development Administration

1.0 Introduction

Remote Sensing & Geographical Information System (GIS) is the backbone for urban planning and management. Essentially it seeks to integrate a large range of spatial and non spatial information with respect to topography & other spatial information including- urban services, infrastructure and socio-economic information. With the help of satellite based map and digital information all the required information are integrated in the GIS based urban management system. This not only helps to unify but also enable updating information as and when required with ease and accuracy. This information can also be made available to the citizens through web based interface. This has specific importance in the context of slums and informal settlements where accurate representation of the ground scenario with that of the socio-economic conditions of the people is a necessity for planning inclusively.

Preparation of these guide lines on 'GIS Mapping, MIS development and integration of GIS with MIS' is mainly to assist the urban local bodies (ULBs) in GIS mapping for their city and slum using different spatial techniques and latest technology for surveying like Total Station Survey, GPS etc. Broadly, these guidelines provide:

- The fundamental concepts of Base map preparation using Remote sensing, GIS and other spatial techniques
- Technical issues involved in GIS
- Integration of GIS and MIS system
- Hardware and Software selection
- Designing training modules (for staff) for GIS (including Remote Sensing), MIS and Total station survey
- Guidance on procuring GIS services from vendors following a bidding procedure

1.1. About RAY

Government of India has announced a scheme for slum dwellers and the urban poor named Rajiv Awas Yojana (RAY), aimed at creating a 'Slum Free India' by giving support to those states who are willing to assign property rights to slum dwellers..
The Ministry of Housing and Urban Poverty Alleviation (MoHUPA) has prepared *Guidelines for Slum Free City Planning* to assist the preparatory activities under RAY and this has been circulated to all States/UTs. RAY calls for a multi-pronged approach focusing on the following aspects:

- Bringing existing slums within the formal system and enabling them to avail the same level of basic amenities as the rest of the town/city.

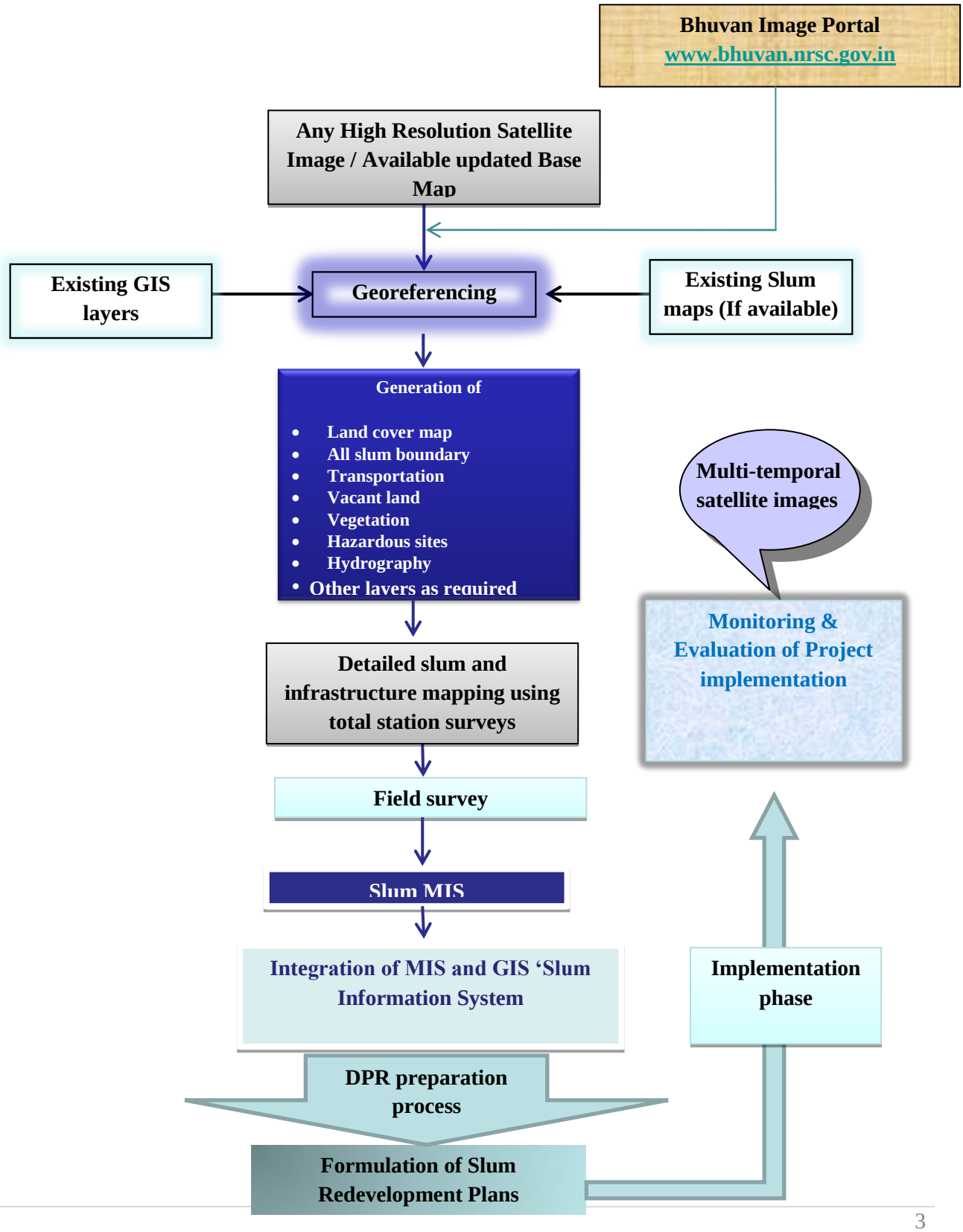
- Redressing the failures of the formal system that lead to the creation of slums; and

- Tackling the shortages of urban land and housing that keep shelter out of reach of the urban poor and force them to resort to extra-legal solutions in a bid to retain their sources of livelihood and employment.

Under the Slum Free City Planning guidelines, there is a requirement for the Urban Local Bodies (ULBs) to build an inventory of existing spatial data available with various agencies. Often ULBs, other than metropolitan cities, do not have centralized spatial data. Under RAY, it is planned to have 'Technical Cell', which will have responsibilities to coordinate and collect data from state governments, NRSC/ISRO, Survey of India, National Informatics Centre (NIC) etc. If the city base map is not available, a base map of the city would be generated using standard guidelines set forth under the project.

As given in the Slum Free City Planning (SFCP) guidelines, the preparation of Slum-free City Plan will broadly involve survey of all slums – notified and non-notified; mapping of slums using the state-of-art technology; integration of geo-spatial and socio-economic data; and identification of development model proposed for each slum. To achieve these things, a systematic approach is essential which will be useful for various other developmental planning initiatives for the urban poor. The present technical manual details the steps to be followed for slum mapping using satellite data, GPS, Total Station Survey in preparing GIS database, MIS development of non-spatial data collected and integration of GIS with MIS to enable generating Plan of Action (PoA) for slum free cities. The whole process could be summarized as per the Flow Chart below:

FLOW CHART


Bhuvan Image Portal
www.bhuvan.nrsc.gov.in
Any High Resolution Satellite Image / Available updated Base Map
Existing GIS layers
Georeferencing
Existing Slum maps (If available)
Generation of
Land cover map
All slum boundary
Transportation
Vacant land
Vegetation
Hazardous sites
Hydrography
Other layers as required
Multi-temporal satellite images
Monitoring & Evaluation of Project implementation
Detailed slum and infrastructure mapping using total station surveys
Field survey
Slum MIS
Integration of MIS and GIS 'Slum Information System
Implementation phase
DPR preparation process
Formulation of Slum Redevelopment Plans

2.0. Guidelines for the preparation of Geo-referenced city base maps

Base map

A base map displays the fundamental data set (key physical features such as, roads, railway network, rivers, neighborhood/slum boundaries, schools, other landmarks etc.) that is used to render sector data more meaningful. A good base map should easily answer the question "Where?" a particular attribute is on the map. The roads, landmarks and other places that are included in the map should be spatially related and correspond to the ground position. Displaying or analyzing the base data with the sector data assists the user in making effective and well-informed decisions.

The content of a base map depends on the user of the map and its intended use. These guidelines are for city base maps that capture slums and related features that are significant in planning for slum-free cities. The geo-referenced base map shall serve as a foundation for different mapping requirements where all other thematic maps may be overlaid for spatial analysis. Thus, it shall aid Planners in preparing slum-free city master plan. It is important for the mapmaker and also the target custodians of this data to understand the procedural steps in the production of base maps, the hierarchy of the sources of data and the nature of the data, in addition to actual usage of the data itself.

Major components of interest:

I. **Content of an appropriate base map** – This includes a list of the base map features needed to be captured, like, ticks/ geographic coordinates, boundaries, natural features like prominent streams, major manmade features like transport network, bridges, important landmarks/ locations and other permanent features, sources for the data, Metadata elements etc.

II. **Procedure for Base map preparation using existing maps/data –** This would cover general steps involved in preparing base maps from existing analogue map data. This shall guide where to look for input data, what to do with such data, and important steps involved in preparation of base map through GIS systems. This will include:
    - Preparation of base maps at coarser levels using SOI maps (1:50,000) and finer scale (1: 2000 or 1:5,000 and 1:500) respectively.
    - Procurement of appropriate high resolution satellite images of towns from NRSC/ other reliable sources. The images (5.8 mt Resolution) available in Bhuvan (Web Geoportal for Earth Observation Data developed by ISRO) can also be used for preparation of Base Map (The detailed information on Bhuvan is given in Annexure XIII)

- Digitization, image rectification, ground truthing and preparation of city base map.
- Listing of all slums and locating them on the base map

III. **Base map preparation (internal or by outsourcing)** – The ULBs shall have to make a self-assessment on their capability to produce the first version of a ULB base map. When it is determined that ULBs do not have in-house capacity to produce base map, help from government /private agencies to prepare base map may be obtained. In this case, the city/municipality shall acquire/provide the available primary or secondary data for the town, with its administrative boundary that further shows the hierarchy of secondary data to be captured.

2.1. Base map features

The basic requirement to start the slum survey is to have a base map at reasonable scale for the city. In this regard, the scale of the base map for the city is recommended to be at either 1: 2000, 1:5,000 and 1: 10,000scale based on the availability. However, preference will be given to the available base maps larger than 1:10,000 scale. However, for each slum, detailed mapping at 1:500 scale will be done through Total Station Survey using GTS benchmark. Care should be taken to ensure that these base maps at different scales will be geographically compatible with each other for seamless visualization and analysis as required under the project. The comparison of maps of different scales is given in the below table (Table 1):

Table 1: Comparison of Different scales

Scale	Application and Utility of the map	Features that can be captured	Benefits & Required resources
1:500	Micro planning (including layout plans of the slum and utility mapping)	All tenements/building footprints and utility information with accuracy can be captured	Ideal for micro level planning -where detailed plans can be prepared using micro details Spatial data at this scale not easily available so has to be generated through large scale mapping exercises. As this takes longer and dedicated manpower, the mapping of slums in the city may be done in phases.

Scale	Application and Utility of the map	Features that can be captured	Benefits & Required resources
1:2000	All functions beginning from utility planning, area planning and city planning	Settlement boundary and utility infrastructure networks can be captured. Tenement boundaries or building footprints are not very clearly visible at this scale.	Detailed information can be captured required for area level mapping. Satellite maps may not be available at this scale. Maps need to be generated particularly for the utilities by superimposing the spatial information available in various forms such as paper maps and /or soft copies.
1:5000	City Planning	Houses may not be visible, but settlements (slum pockets), road networks and broad city level infrastructure can be captured	Broad information can be captured as required for the city level base map. Spatial maps and remote sensing images at this scale are available for certain cities; for others this would need to be generated through topographic surveys. For utilities the trunk infrastructure (or primary system) would be captured so as to utilize this information for city planning and then further onto area and slum planning.
1:10,000	Regional planning (city planning can be done but with limited information as at this scale many spatial features are not	Lanes and service roads may not be visible but arterial roads and settlement blocks, regional landuse /landcover information would be visible	This scale is appropriate for regional planning but for city level planning the information available might not be adequate. Spatial maps /remote sensing images at this scale are

Scale	Application and Utility of the map	Features that can be captured	Benefits & Required resources
	visible)		generally available for all cities. Information on utility and infrastructure would be captured at zonal level like electric sub-station, connecting transmission mains, zonal water reservoirs, etc

In building the GIS for slums by ULBs, there would be two forms of base maps; first one in the digital form composed of different layers of digital files for each feature of the base map and other one will be the printed version of the same. The layout of the printed base map should have standard map features such as scale, north arrow, title, legend etc. Both forms of the base map (digital and printed versions) should have same features. The Base map features vary with scale of mapping and hence care should be taken to define the base map features in accordance with the scale of mapping

The following broad features are recommended to be included in the base map. The potential source of the data will be from Survey of India (SOI), State Remote Sensing Application Centres (SRSACs), Urban Local Bodies (ULBs)/ Municipalities, etc. (Table 2).

Table 2: Base map features & potential sources

Base map features	Potential source of data
Administrative boundary	
State Administrative boundary	Survey of India (SOI), Open Series of maps
Municipal and ward boundary	ULBs
Slum/Habitations boundary	ULBs/Municipalities, generate using satellite data, GPS based field data
Natural features	
Natural landmarks	SRSAC, ULBs, SOI, generate using satellite data ,GPS based field data
Stream, creek	SRSAC; ULBs, SOI, generate using satellite data ,GPS based field data
Man-made features	

Roads: National; City/Municipal/Slum (line segment)	SRSAC, ULBs, SOI, generate using satellite data satellite data
Railway (line features)	SRSAC, ULBs, SOI, generate using satellite data
Airport (line features)	SRSAC, ULBs or Directorate of Economics & Statistics, SOI, generate using satellite data , GPS based field data
Built-up area of slums in a generalized manner	Satellite imagery, aerial photograph, GPS based field data
Other landmarks such as temples, mosques, church etc. (points or polygon)	SRSAC; ULBs, SOI, GPS based field data
Contour lines	SOI, Ground Survey
Cadastral maps	ULBs, land records and survey (LRS)

For illustrative list of data layers, codes and attributes required from them please refer to **Annexure II, III and IV.**

2.2. Guide to prepare GIS based city base map

2.2.1 Hands on description of preparation of base map using existing data

Obtain paper prints (heavy paper) of the base map, preferably without topography. The base map print can be a blue line or black line copy with plenty of extra space for notations. Hard copy of the latest high resolution satellite image or print of the land use map of the municipality or ULB from available database in considerably large scale may also be used.

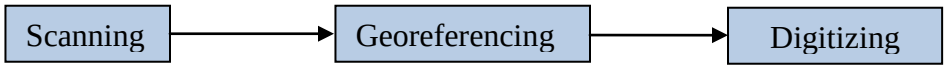
The following information should be shown on this map:

- Identification and demarcation of slum areas and vacant areas on a base map **(Annexure** II)
- Land use
- Roads, streets, highways, railways (with names);
- Lakes, major wetlands (with names);
- Rivers, streams, creeks (with names);
- Names of points of high elevation;
- Vulnerable areas
- Settlements within the community;
- Name of municipality, north arrow, scale, preparation date.

Note: At the time of household survey, the existing land use of the slum shall be noted and compared with statutory land use as notified in the CDP / Master Plan.

2.2.2 Steps for preparing base map under GIS domain

The following broad steps show the generic procedure in the preparation of a base map showing the various data types which the ULB should acquire under GIS environment. Data may be in two forms, the technical description and the paper map. The capture of data from the technical description involves a more direct step of encoding the numerical data into the computer, which is further converted to points or shapes. The capture of data from paper maps involves three steps as described below:



Data captured using GPS, will be processed directly by importing the points for appropriate storage, attributing and depiction. It is also recommended to use the Projection and Datum of the source, if already available during Geo-referencing. Re-projection should be done on the digitized layer or output vector file. When combining GIS layers from different sources, there

may be discrepancies in dataset, hence care must be taken to maintain consistency with respect to output projection parameters for proper registration amongst such layers. .

Roads digitized from Cadastral maps, even after due geo-referencing, may not coincide with the roads taken from a Topo map, even if these layers were set to the same projection and datum, due to significant difference in mapping scale and other factors. If corrections or adjustments are done, documentation for the adjustments should be attached to the metadata. Any errors or discrepancies found on the source maps should be reported and consulted with concerned agency.

2.2.3 Administrative Boundaries of the slums

Data for administrative boundaries especially for non-regularized slum boundaries may come in two forms, technical descriptions and paper maps. It is critical to identify the source of administrative boundaries of such slums. Sources available with ULBs like topomaps should be given less weight as compared to the legal proclamation adopted by the ULBs in recognition of regularized as well as un-regularized slums. The output base map should not be used for property delineations or for settling legal land encroachment issues. Boundary conflicts, if any, should be captured and saved in a separate layer and should be consulted or settled with concerned agencies.

a) Create the boundary using technical description/ coordinates

ULBs, municipalities and municipal corporations usually keep records and technical descriptions of slum boundaries. In cases, where geographic coordinates / grids are available, it is better to use these data and maps. When such data or descriptions are not available, field methods like Total Station Survey or GPS points needs to be used to identify legal boundaries of regularized or non-regularized slums in the cities.

b) Capture the boundary using the paper maps

This procedure refers to paper maps with plotted administrative boundaries. They are the plotted paper maps of the boundaries from surveys. These datasets usually come in monotone color (black ink in white paper or blueprint). If the map also includes technical description or coordinates, digitization of paper maps becomes easy. These maps need to be scanned, geo-referenced and digitized in order to convert them into the digital map. The procedure is as follows:

1. Review and inspect the map. Make sure that it contains tick marks with coordinates. There should be at least 4 tick marks with coordinates, but it is often seen that they do not produce

accurate results. Hence, maximum number of ticks (16 ticks) needs to be taken to ensure consistently high accuracies. Make sure that the tick marks selected are visible.

2. Get familiarized with the projection and datum of the maps. If the ULBs have access to GIS facilities and have created maps using standard GIS software, a projection and datum for that ULB will have to be provided.

3. Prepare maps for scanning. Smooth all folds and crumpling. Fix and align torn out portions, if any.

4. Scan and save images in .jpeg/ .tiff format.

5. .Check for image distortions and clarity of map features and make sure that the tick marks or reference points to be used are clearly visible on the scanned image. Rescan, if necessary.

6. The process of defining the position of geographical objects relative to a standard reference grid is known as Georeferencing. It is a system that links information to a position on earth's surface. It is done by assigning map coordinates to image data for making the data amenable to GIS analysis, and to facilitate viewing in conjunction with maps. Geo-reference the scanned image using all possible tick marks as map control points. The detailed procedure along with the illustration for geo-referencing is given in **Annexure I.**

7. Crop the image. Remove areas outside the neat lines of the map with the software, if possible. Resample and save the geo-referenced image using a different name and file format which is readable by the digitizing software.

8. Load the geo-referenced image using the GIS software for digitizing and perform on-screen digitization. The procedure of digitization along with the illustration is given in section 2.2.5. Use standard GIS software for scanning, digitizing, georeferencing and creation of a universally compatible file, like shape file format.

9. Create the municipal, zonal and ward boundaries layer as a polygon. Digitize the boundaries from the geo-referenced image. Save the file using standard file naming convention. In case of boundary conflict/disputes, create a different layer for this area, label and save it accordingly.

10. Create the slum/habitations boundaries, from the same source, for the municipal boundaries. Use tools to split or append polygon if available with the software.

11. Label or encode the feature name while digitization process. Slum names should be labeled as attributes. Make sure to save the slum layer, created as a different file, and do not

overwrite the municipal boundary file which is used as a base layer. Follow standard naming convention. Create metadata for each feature type created.

2.2.4 Geo-referencing of paper maps

Once a paper map containing information in present scenario, slums in a town or city, is scanned save it as a digitized image. Assuming the municipality or ULB is using any standard GIS package, (the list of standard GIS Packages has been provided in Annexure XI) the scanned image will be brought on to a new project. Existing city base map is made available as a separate layer that can be activated. The image that is imported can be geo-referenced using any Georeferencing tool. Georeferencing of raster maps (images) involves various steps which is illustrated as an example using one of the software tools. This also includes the procedure for CAD based paper maps or toposheets (**Annexure I).**

2.2.5 Data Collection of slum points using Global Positioning System (GPS):

1. GPS is a simple device using which necessary field data could be collected as needed. Appropriate projection parameters as decided need to be used for mapping purpose.
2. For each of the features needed, create a corresponding layer with appropriate feature type. Label or encode the feature name while it is digitized. Save the file into different files following the recommended file naming convention.

3. Create metadata for each feature type created.

2.2.6 Preparation of base map, in case no GIS data is available

Natural, man-made features and other major landmarks of every urban areas and cities may already be available with the ULBs, Municipalities and Municipal Corporations. If no GIS-enabled data is available, refer to the much simpler procedures below:

1. Refer to the section on scanning and georeferencing.

2. Refer to Standards for Base map features to identify for the necessary feature type to use for each required feature.

3. For each of the features needed, create a different layer with appropriate feature type.

4. For the above layers, if the feature thickness is more than admissible size in some parts, digitize from the center of the feature. Create a separate polygon layer for some roads and rivers represented as areas in the topographic maps.

5. For features like schools, landmarks, etc., which can be identified on the map, create point layers. If not identifiable and handheld GPS survey is not possible, use the scanned map in locating the position of the feature. However, it is advised to carry out field surveys for these features for validation and accuracy using GPS.
6. Label or encode the feature name as it is being digitized. Save it into different files following the recommended naming convention.
7. Create metadata for each feature type created **(Ref Annexure VI).**

2.3. Outsourcing for GIS base map preparation

Base map is a fundamental dataset for ULBs; therefore it must be prepared correctly. In case ULBs do not have the capability to create base maps, it is recommended to outsource the work to State Remote Sensing Application Centres or Agency with expertise in image processing and GIS. The ULBs may opt to request the services of a Remote sensing and GIS expert in the respective States, whether within the government or otherwise. The following guidelines are given below:

1. The ULBs employ the services of Remote sensing and GIS expert / consultant using the norms and standard procurement procedures.
2. The Remote sensing and GIS expert / consultant will submit a proposal to confirm the assignment and identify budget and scope of work to complete the job. This will be based on the requirements' documents provided by ULBs to the consultant.
3. A contract will be signed in tune with the TOR mutually agreed upon.
4. The Remote sensing and GIS expert / consultant prepares draft implementation document based on the overall requirement and considering the existing in-house data available with the ULBs. The Base Map data will be generated considering requisite source by data for encoding, scanning and digitization.
5. If ULBs are capable, they could conduct surveys to capture complementary data using a handheld GPS. If the ULB is not capable to undertake such field surveys, it is recommended that the expert / consultant could be entrusted with the job and assisted by ULB or Municipal Corporation staff as per the terms and conditions defined.
6. If ULB is capable of in-house GIS skills, the ULBs will complete the data capturing, input data into GIS format and send it to the expert/ consultant for finalization. Otherwise, the GIS expert/ consultant will do the job.
7. The Remote sensing and GIS expert/ consultant prepares a final draft and ensure that the base map is in appropriate geographic reference system. The output map shall be validated, so that the information requirements of the municipality are met. Revisions of the outputs will be done, if any defects are detected during checking.
8. The final draft is turned over to the ULB for final approval.

Note: If the ULBs outsource the work to a consultancy firm, it should include all the components such Inventory of existing Spatial Data, Obtaining Satellite Image of the City and its Fringes (planning area), Geo-referencing of Satellite Images and preparing Base Map for entire Urban Agglomeration area, Identification & Demarcation of Slum areas & Vacant Lands on Base Map and Delineation of Slum Areas and Mapping Slum Infrastructure with spatial surveys (like Total Station survey/ GPS etc) of the slums intended to be taken up in the first phase.

3.0. Slum Survey and Mapping – using GIS, Total station surveys, and GPS

3.1. Introduction

Taking cognizance of the city level base maps prepared by the ULB, slum level map using GIS and other necessary spatial surveys will be prepared. All slums whether notified or otherwise must be mapped in phases for undertaking slum upgradation and/or redevelopment. In addition, socio-economic surveys will be carried out covering household surveys. Maps and survey data when completed and verified shall be made available on a web based GIS-MIS system.

3.2 Objectives

The main objectives of house hold survey and web based GIS- MIS are as follows:

- Build GIS based slum plans for decision support system in Urban Local Bodies.
- Map as many slum areas as possible in phases
- Collect relevant Slum socio-economic data for future analysis.
- Present a comprehensive picture of the slum i.e., non-spatial and spatial data supported on a comprehensive MIS
- Create a GIS based slum database and maps, which will be accessible to all.
- Help ULBs to prepare detailed project reports (DPRs) and action plans of slum areas.

3.3. Slum survey procedure

The socio-economic survey can be carried out by ULBs on their own or through engaging an agency through an open transparent procedure .This survey must involve the communities; and be implemented concurrently in all slums in the ULB. Before survey work begins, it is mandatory that public should be informed through a press release or a local newspaper article. Ideal procedure would be to have a well planned “Entry Point Activity” under the project, wherein the implementing authority will have a focused group discussions with the slum groups, sensitize them about the RAY using participatory approach, build confidence amongst the slum community by implementing a small slum community program and ensure strong participation of the slum dwellers with the program. The components of the survey are as follows:

Component I: Slum Survey (General Slum Profiling) attributes

Basic information on slum, land status, demographic profile, housing status, economic status, occupational status, access to physical infrastructure and their connectivity, health facilities, social development/welfare facilities available to the slums, and additional infrastructure requirement.

Component II: Household Poverty, Socio-economic (Livelihoods) and Infrastructure Survey

Information on each slum notified or non-notified located within the boundaries of the ULB will be collected.

- Scale, type and condition of infrastructure for roads, the survey will obtain information on existing pucca (and their type WBM/BT/CC) and kutcha roads, their condition and distance to the main town / city road system.
- For storm water drainage, the survey will obtain information on existing storm water drains, whether they are pucca or kutcha, and their place of disposal and distance thereto. Location of culverts and their condition also shall be captured.
- For water supply, the survey will obtain information on size, material and condition of pipes, the source of supply like ELSRs/GLSRs/sumps.
- For sanitation, the survey will obtain information on the material, size and length and condition of sewer lines, their connectivity to town wide sewerage system, septic tank and its condition and point of disposal, number and condition of Community toilets / Public toilets.
- For street lighting, the survey will obtain information on the location of lighting poles, existence of lighting fixtures and distance to nearest transformer and its capacity.
- All these sectoral components shall be presented in GIS overlays.
- Provide an infrastructure map for the whole slum and data at agreed geographic disaggregation to generate the indicators as listed below, as well as a summary report indicating service levels within the slum. The summary should supply, but not be limited to, the following information:
    - Percentage of road length not covered with pucca drains,
    - Percentage length of roads which are not pucca,
    - Percentage length of roads without street lights,
    - Percentage of households not covered with piped water supply,
    - Number of hours of water supply per day – dry and wet seasons,
    - Percentage of households not covered with toilets,
    - Percentage of households without solid waste collection,
    - Access to health facility (UHC/PHC) within half kilometer distance from the slum,
    - Access to primary education facility (primary school) within half kilometer distance from slum

- Access to community halls.

In each slum, the survey will also include a separate exercise of inspection, mapping and focus group discussion to ascertain availability, levels and quality of basic service provision. Services to be assessed will be roads, street lights, drains, water supply, and sanitation, solid and liquid waste disposal. The city level technical team shall ensure that urban poverty alleviation staff SHG members are always involved in the survey exercises, data verification, data validation and reporting.

* Note: Slum household and livelihood survey will be carried out using the NBO formats and involving the community.

3.4 Prioritizing slums for detailed slum mapping - using total station survey or other spatial survey techniques

In case of slums for which satellite based GIS maps or even usable basemaps are available, it is required to carry out detailed physical survey using Total Station Survey Method to incorporate very scale spatial information for planning. Moreover, undertaking survey of every slum in the ULBs using Total Station method has limitations in terms of cost and time. All slums need not be surveyed using Total Stations. Some of the slums could be covered using hand-held GPS instruments also based on the size of the slums. To prioritize the slums to be surveyed using Total Station, information obtained from the house-hold surveys will be used with specific parameters for decision making.

The slum mapping exercise will result in the preparation of digitized slum map at 1:500 scale with a peripheral belt of 200 metres. Extract of the related slum base map at 1:500 scale will be taken in the print form in A0 size and will be handed over to the technical field surveyor for incorporating spatial data in respective slum base map using total station survey or other large scale spatial mapping techniques. For the preparation of digitized base map of the slum, the following information needs to be collected from the field survey/total station survey:

- Slum boundary with schedule of boundaries of related slum / slum pockets.
- Width and length of plots of all occupants, building foot prints.
- Approach road, streets, lanes, by-lanes in the slum.
- Existing land use such as residential, commercial (petty shops) or others.
- Type and length of existing roads (CC, BT, WBM and earthen)
- Existing water supply lines and details of PSPs, bore wells, hand pumps and individual connections.
- Details of sewerage, storm water and Sullage drains and the pucca / kutcha drains leading to final disposal points.

- Sanitation services – individual, community and public toilets.
- Solid waste management system with details of dustbins and collecting points.
- Street lighting with pole number, location and type of fixture and distance to transformer and its capacity.
- Community hall, anganwadi centre, PHC/HC, primary school and other educational institutions.
- Contours at 0.5 m and 1.0 m intervals shall be incorporated through total station or similar spatial survey techniques.
- Vulnerability mapping of the slum and the determined peripheral belt using Digital Elevation Model (DEM). DEM will help to identify the vulnerable area on which slum pockets exist and also vacant lands prone to hazards (like flooding, landslides, etc). This helps to identify the possible untenable slums and areas for relocation.

Whenever total station surveys are carried out, care should be taken to establish control points and temporary bench marks (TBM) at suitable locations during survey for use at a later stage or during implementation of works. The list of such control points and TBM shall be recorded both in drawing as well as in MS excel format.

During the survey, all levels should refer to Mean Sea Level. For this purpose, GTS benchmark should be used. If a GTS benchmark it is not available within the town or city, the nearest GTS benchmark should be used to establish one or more control points using a closed traverse. It is required to capture at least levels on the road intersections/junctions covering the entire slum up to points of connectivity to town wide infrastructure with respect to water supply, sewerage and storm water drainage systems like ELSRs/GLSRs/Sumps/pumping stations etc. While the Total Station Survey generally captures all surface features, underground utilities like water supply, pipeline, sewer line, electric cables etc will have to be superimposed on drawings generated out of Total Station Survey.

In general, Total Station Survey drawings are plotted on CAD platform. These drawings need to be converted into the GIS platform for the sake of uniformity.

3.5 Involvement of local community during slum mapping

Community participation should be ensured during the slum mapping exercise. The broad guidelines for involving communities in the mapping process are given in Annexure X. In this respect the following process/action may be noted:

- Conduct of workshops with participation of experts and NGOs and finalization of slum survey formats
- Conduct extensive training to ULB staff in detailed slum profiling.
- Conduct detailed slum profiling by ULB staff.

- Slum profiling will provide land status, demographic profile, housing status, economic status, occupational status, access to physical infrastructure and their connectivity, health facilities, social development/welfare facilities available to the slums, and additional infrastructure requirement.
- Conduct extensive training to ULB staff and Slum Level Federations (NHC)/community volunteers and field supervisors etc. in slum household socio-economic survey.
- Conduct necessary workshops amongst stakeholders to identify and freeze on necessary indicators and parameters for the project in line with project objectives.
- Conduct household socio-economic survey.

Note: Preferably, entrust the entire exercise viz., geo-referenced city base map using satellite data (mentioned in section 2) , mapping using total station and GPS instrument, mapping in CAD and GIS integration to one single agency capable of handling the same to ensure proper and effective coordination. The agency may further associate with or outsource it to expert/ consultants /surveyors, if it lacks in-house expertise in some of the areas.

4.0 Development of Slum Management Information System (MIS) and its Integration with Geographic Information System (GIS)

4.1 Introduction

Socio-economic surveys are undertaken by the ULBs and the statistical data collected from surveys is being maintained in the respective databases of the ULBs/States. It has been found that the survey data collected is not in uniform format and presents difficulties in streamlining and centralising the data at single source for easy analysis and review by the Ministry. To overcome these limitations, the data collected through surveys will be maintained in a central database with necessary redundancies following a uniform format that can be universally accessed across the project areas. This is achievable by implementing a project-wide MIS, enabling online data entry across the project areas to maintain up-to-date data and information on all slums under the entire project.

One of the key components to implement the programme successfully is a system of identifying the gaps in the existing system; monitoring the implementation against the targets, and tracking the physical and financial progress on a concurrent basis. In view of the specific requirements as identified above and to develop a national-level centralized information system, following actions by National Building Organization (NBO), MoHUPA were conceived.

Pre-requisite to build a strong MIS is to identify project specific indicators on which the data need to be collected and analysed for decisions. Finalise the data formats to match all requirements of the indicators. Finalise the structure of the database elements of MIS and build a matching coding standards for GIS attributes so as to enable a synergy amongst MIS and GIS database elements.

- Design data entry formats for conducting Slum/Household/Livelihood surveys and circulate to all the States and Cities. This will ensure uniform data entry and analysis across the project areas.

- Detailed guidelines indicating the instructions to be followed for conducting the surveys has also been circulated.

- Development of National-level web enabled 'MIS' for Surveys and its maintenance is assigned to Centre for Good Governance (CGG). This will enable a national level MIS which will have hierarchical usability from city/town/taluk/district/state to nation. Respective States could create their own databases through online transactions on the MIS, viewable at all levels for monitoring and project management.

- Development of necessary linkages of GIS databases of the respective States to the web based MIS to enable integrated MIS-GIS utilities for online usage.

With the increasing consensus on the importance of having better information systems to support the poverty alleviation efforts, a Monitoring System has to be designed. The Monitoring system envisaged comprising two components (**Figure 2**):

- MIS for Surveys (baseline and monitoring) - Database of all the information collected through the surveys of Slums/Households/Livelihoods starting from baseline information. The statistical analysis of the data will indicate the current inadequacies in the slums and assist in gap analysis and future planning.

- On-line Project Monitoring System - Monitoring system to track progress against the agreed action plan, monitor the physical and financial progress of the project through online input-output analysis of the data.

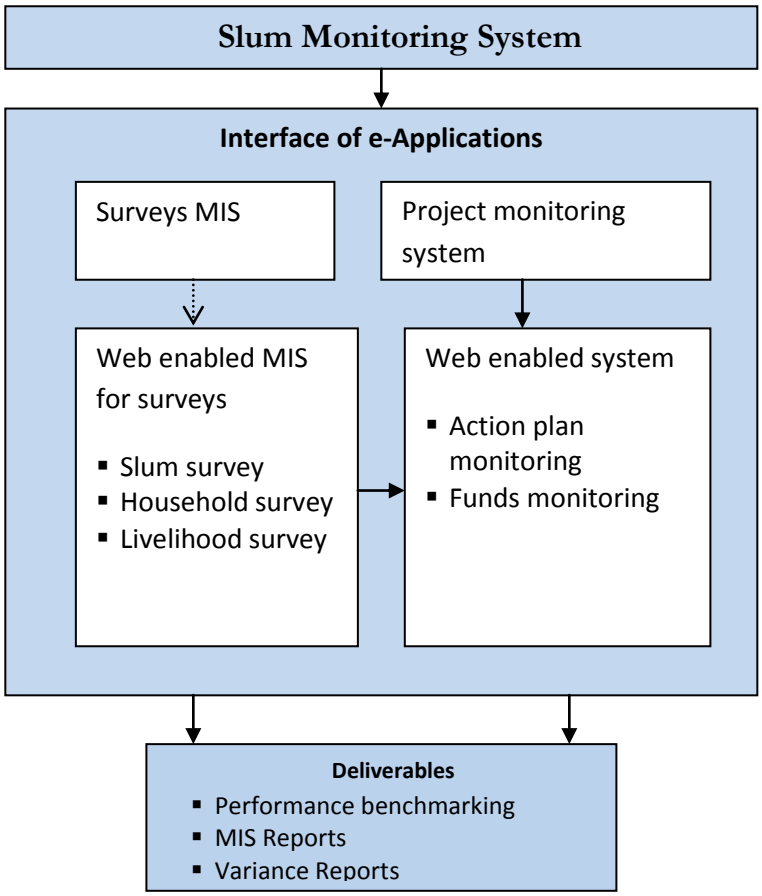


Figure 2: Framework for Monitoring System

4.2. Design of Slum Monitoring System and the Management information System (MIS) for Surveys

The Management Information System (MIS), for Slum survey/Household survey/Livelihood survey is a web based online tool developed to build a robust information system on facilities available in slums and also about the socio-economic profile of the households and their livelihoods. The system is developed by the Centre for Good Governance (CGG) for Ministry of Housing and Poverty Alleviation (MoHUPA) and maintained on behalf of the Ministry.

This MIS is a databank which enables data input, analysis, monitoring and planning with multi-faceted benefits such as:

- Information for Planning & Policy making.
- Identification of livelihood needs like primary education, training, employment etc. in each slum area and decision-making on the requirement of needs or the area of focus for development of individuals as well as slums.
- Identification of current literacy levels, child labor, under employment etc; take appropriate steps to overcome shortcomings.

- Contains all the baseline information of each of the slum area taken for development.
- These baseline indicators are further used for monitoring and management during implementation of action plans
- Integrates required indicators from the action plans/ DPRs as a part of MIS for online monitoring.
- Produces regular reports and graphic analysis of the data analysed.
- Maintains an integrated GIS with compatibility between MIS and GIS using unique coding mechanism. That is, GIS map queries will be able to fetch MIS reports and similarly, MIS tables could fetch specific GIS outputs as required for cross comparison.

4.3. Features of MIS

The key stakeholders of the MIS[1] are all ULBs, States and the Ministry of Housing and Urban Poverty Alleviation. ULBs will conduct surveys and input the information into MIS/GIS system. Concerned authorities at State and at the Ministry can review all reports, maps for periodic monitoring and progress of the surveys. User Manual has been prepared and made available as an online help through a 'Help' option.

For using the MIS/GIS tools, the ULBs need to conduct surveys in the formats prescribed by MoHUPA, duly following given guidelines. After completion of the surveys the details should be entered into MIS and reports are to be generated under it; a provision to prepare reports is inbuilt in the e-tool.

4.4. Data Input

a. Details to be captured for slum survey:

i. Section I-II

- Basic Slum Information
- Land status

ii. Section III

- Demographic Profile

[1] The MIS module developed by CGG is a web-based application using open source technologies like RHEL 5.0 as operating system, Postgres 8.1 as database, Java technologies for the front-end development; Tomcat 6 as web server. The application is accessible universally with basic internet connectivity with necessary access mechanism.

iii. Section IV-VI

- Housing Status
- Land Tenure Status
- Economic Status of Households
- Occupation Status of Households

iv. Section VII

- Access to Physical Infrastructure facilities

v. Section VIII-IX

- Educational facilities
- Health facilities

vi. Section X

- Social Welfare facilities

vii. Section XI

- Additional Infrastructure requirement

b. Details to be captured for Household survey

i. Section I-III

- General Information
- Household General Information
- Household detailed information

ii. Section IV-V

- Migration details of household
- Income-Expenditure details of household

c. Details to be captured for Livelihood survey

i. Section 1(a)

- Details of earning members of the household

ii. Section 1(b)-1(C)

- Education & Training Details of earning members
- Employment & Earning details of earning members

iii. Section 2-5

- Source of earning
- Reasons for Unemployment
- Preferred area for training/skill enhancement

4.5. Outputs/ reports which aid in analysis

Based on the design for query on specific parameters, several analyses reports can be generated through the MIS system, as brought out above. Some of the parameters on which reports can be generated include:

a. Slum Reports

- Number of Notified/Non-Notified slums in State/UT's.
- Distribution of slums according to area in State/UT's.
- Demographic and health profile among different social categories in the state.
- Distribution of slum population among different social categories in the state/UT's.
- Distribution of slum BPL population among different social categories in the state/UT's etc.

b. Household Reports

- Distribution of slum households by religion in states/UT's
- Distribution of female headed household in slum according to the marital status for each state/UT's
- Distribution of illiterate adult members in the slum household according to the sex for each state/UT's
- Distribution of families below poverty line in slums in States/UT's
- Distribution of slum household by land tenure status for each state/UT's, etc

c. Livelihood Reports

- No of earning members of slum households in states/UT's
- Distribution of earning members of slum households according to age groups in states/UT's

- Distribution of earning members of slum households according to religion in states/UT's
- Distribution of earning members of slum households according to employment status in states/UT's
- Distribution of earning members of slum households according to distance to place of work in states/UT's, etc.

All reports have the capability for drilldown reports and the data can be viewed up to lowest possible level. Depending on the user query, GIS maps will also be made available with the MIS reports. Similarly, GIS maps at different scales (as prepared) should be accessible for query, display, analysis and print.

These are to supplement the requirements of the ULB/consultant in the preparation of slum development plan, duly incorporating the existing situation.

4.6. MIS Implementation strategy

The MIS developed is a national-level MIS and all States and Cities have the option of entering survey data into the system over the web interface. This will enable the Ministry to monitor and review progress of the project on different components at all levels including national-level. This can be done by following any of the options discussed in the next section.

4.7. Options for implementation of MIS/ GIS

4.7.1. Option – 1: Using the online/web-based system

All states and cities can access the National-level MIS which is a web enabled system and can be accessed universally. Survey data has to be collected in the formats prescribed by MoHUPA and the data entry has to be done in the MIS system. However, respective States should be able to use the GIS maps online as needed under the project. At national level, there should be provision to select specific maps for display, analysis and query as needed. Web based application is accessed through a web browser over networks such as the Internet.

4.7.1. Option – 1: Using the online/web-based system

Merits are:

- There is no requirement of separate hardware and software at the client-end and therefore there is not much investment in the infrastructure required for implementation of the MIS/GIS
- Additional technical manpower requirement will not be needed at the client-end, as the technical issues will be resolved at central-level (MoHUPA).

- Applications can be accessed universally with necessary restriction policy in place.
- Client will always have access to updated software and need not put efforts in updating the software and hardware.
- Browser applications typically require little disk space at client-end.
- They also provide compatibility to run the applications on any operating system in most cases (i.e., Windows, Linux, etc.) because they operate within a web browser window.
- Data is automatically compiled at the Ministry and reduces the workload in compilation of data and sending it . There are no issues of data Synchronization because the web based tool stores the data in central data base itself.

Demerits are:

- Clients may experience difficulty in data entry in places where internet connectivity either does not exist or is slow.

4.7.2. Option – 2: Using Offline tools

The States/Cities which experience connectivity problems or those who would like to include additional MIS parameters can adopt Option-2 discussed below.

The application developed for Nation-wide use should be taken as a model for the development of the offline tool and can be deployed locally. The offline tool may be preferably developed using open source technologies like Java, Postgres SQL etc. During the development of the offline tool, it should be ensured that the same data structures as that of the National-level MIS/GIS are followed, so that problems do not arise in exporting MIS data into National-level MIS.

It is also possible to install the same package (i.e., the web based MIS/GIS package) at those places which are supposed to be working offline. While installation, "localhost" settings could be enabled and also while database entry, a parallel SQL file could be created from the software so that these files could be sent to the HQ/ Server installation site for upgradation regularly.

Data Structures are available with national resource centers such as the Center for Good Governance (CGG), Hyderabad and are available for use upon request. MIS can be customized following CGG data structures and also additional parameters if any can be included based on the requirement given by the monitoring authorities in the States. The survey information entered in the offline tool should finally be exported into the National-level MIS/GIS system. This can be done by accessing the National-level MIS/ GIS through secured login assigned to them and export the data into MIS using the inbuilt export option. The data should be exported only in the form of '.sql file'/ .mdb. It should be ensured by the system administrator that the data exported should only be in the file format based on National-level MIS/ GIS and it should not contain any of the additional fields included.

Highlights of Offline System

- Data entry can be done faster as it does not depend on the internet connectivity.

Demerits are:

- Client has to invest for the infrastructure and install the necessary hardware and software at their end
- Client will not have an automatic access to the software updates and needs to do it manually
- Client may require technical manpower to manage the technical issues that arise in maintaining the hardware and software
- Updated data cannot be immediately compiled & seen at the Ministry level. It has to be done manually using the service provided in the application for data Synchronization. However, on a regular basis the data can be uplinked to the server for data synchronization and hence will be online with some delay.

4.8. Data Migration of existing MIS data into the proposed MIS

Some of the States and Cities may have developed specific Management Information Systems suiting to their needs. There may be data available in their existing systems. To avoid duplication of data entry, the existing data needs to be carefully exported from their current database to the proposed MIS. This could be possible only if there are matching fields in the database structure. If the two structures are completely different, there is no possibility of any import/ export.

4.8.1. Steps to be followed to enable migration – only if data structure is compatible

The best possible methods for exporting the data from their current information system to the National level MIS are:

- Users to access the MIS created for surveys at http://surveys.cgg.gov.in and download the MS Access database from the 'Admin services' of the menu by logging into system.
- Convert existing data structures in the form similar to that of the given Access data structure
- The existing data should now be exported into the targeted MS Access database
- The '.mdb' file that is generated can now be uploaded by logging into the National-level MIS through secured login assigned to them and export the data into MIS using option given for exporting the data.

Note: MS Access data structures are being given to ensure that the data exported into the National-level MIS is adopting the same master data and key validations used in the National-level MIS.

4.9. Outcome

The outcome of the 'MIS for surveys' will be the reports that assist in the prioritization of the slums, indicative reports on the existing facilities in the slums, etc. Based on the statistical data of this MIS, ULBs/States should be able to prepare an action plan for the project monitoring purposes.

4.10. Project monitoring system

The project monitoring system suggested in these guidelines are preliminary. Monitoring parameters would evolve when RAY is implemented. Parameters identified based on implementation and execution bases will be comprehensive. However, at the juncture, the monitoring system may include the:

- Provision to capture the State-wise & slum-wise targets for the identified parameters
- Provision to capture Physical progress and financial progress against the defined targets; this parameter may include number of slums rehabilitated or retrofitted with infrastructure etc.
- Ability of the system to generate monitoring reports on the progress of project implementation.
- The project monitoring system fully depends on what database is created for baseline. The monitoring parameters will also have similar data structure as baseline based on the indicators chosen as a part of the design.
- Out of the many baseline parameters, specific monitorable parameters need to be selected and used for project monitoring with a focus on physical and financial performance.
- This could also have necessary interface elements with GIS tools to show map-wise implementation status of the project.

The design of the 'Project Monitoring system' needs to be worked out in further details after the implementation of the 'MIS for Surveys' since, the focus parameters should be identified based on the statistical data analysis of the current scenario.

4.11 Guidelines for integration of GIS with Slum MIS

Integration of GIS with slum MIS means matching the common parameters (fields) from the attribute table of the spatial data (Map) with MIS based common fields. This would enable the ability to view the integrated data and prepare reports. Steps to be followed for Integration of MIS with GIS are:

4.11.1. Identification of common parameters

Assuming that the City Base Maps have been prepared by the ULBs, based on the project guidelines, corresponding shape files (digital GIS map) would be available with necessary attributes.. To match the information available in MIS with that of GIS, it is required to have matching fields in both MIS database and the attribute table of the shape file with similar table properties. If such an attribute field is available, by following a simple 'table merge' operation in GIS, MIS data can be integrated with GIS attribute tables. Or based on the query, necessary table content can be fetched, formatted and produced as a report/ answer to the query.

Alternately, using 'edit' option, in the GIS software, fields that have parameters in the MIS can be created and populated through a manual process. Therefore, it is critical to identify the parameters/ MIS attributes that are proposed to be linked to the spatial data.

4.11.2. Preparation of data for Integration

After identifying selected parameters from both MIS and GIS, necessary database links should be established for compatible database fields that could enable unique data access between the MIS and GIS applications. This will enable unique query mechanism either from MIS or from GIS. The Web based MIS/GIS should be designed as an integrated MIS and GIS system to facilitate such features automatically.

One of the methods is the creation of views for the data sharing. Spatial data as well as the attribute data shared between GIS and MIS may be saved separately. Similarly, both can separately use non-shared data. A good database-level integration involves integrating all data with a single database. For example, Spatial data on RDBMS can save both spatial and attribute data, enabling access and modification to spatial and attribute data from MIS and GIS applications. The best overall solution is full integration of both databases and user interfaces.

4.11.3. Data Analysis & Integration

After preparing slum maps, either by digitization of paper maps as discussed under a separate heading 'Guidelines of preparing City Base Maps' or by using GPS or other means, the attribute table associated with these shape files needs to be integrated with necessary linkages to the MIS data. However, as explained above, identifying compatible fields or parameters is critical in achieving the integration. Spatial data is usually captured as points, lines or polygons. Each of these shape files have associated attribute table with fields and data populated. Ideally, if the fields or parameters, that are in the MIS system, have similar data structure with the attribute table of the shape files, integration of the data would be simple and straight forward.

Similarly, other infrastructure information, if available in spatial format could be brought onto the interface as a separate layer and activated or de-activated depending on the need.

It may become necessary to either modify existing MIS to suit to integration with GIS or identify a field that is common between GIS and MIS. Please refer to 'Guidelines to prepare City Base Map' guidelines for further clarity.

Illustration of data integration from MIS to GIS is appended in **Annexure VIII**.

5.0 Guidelines for Technical Support Institutions/Agencies/Consultants and the norms of engagement of Technical Consultants to be engaged by the States/Cities under Rajiv Awas Yojana (RAY), MoHUPA.

5.1 Introduction

This section is intended to provide guidance to the ULBs regarding the work to be carried out for mapping by external agencies such as Technical Consultant and / or institution to be engaged by the ULBs in the event that the ULBs themselves are unable or not in a position to carryout the work themselves. The quality checking of the deliverables may be carried out by the ULB through a Third Party Inspection Monitoring (TPIM) process.

5.2 Scope of Work

5.2.1 Brief Description of work

The work may comprise either or both (i) city level mapping and (ii) mapping of slums in a particular ULB. In case of City level mapping, the work will comprise preparation of Base Maps of the geographical area generally within the ULB area and around, depending on specific requirement of a ULB. The Base Map will depict all physical features like roads, highways, railway lines, parks, open areas, water bodies (e.g., rivers, canals, nalas etc.), administrative boundaries like municipal boundaries, ward boundaries etc. in separate layers, In case of Slum Mapping, the work will comprise of preparation of maps of slums showing each property or structure, lanes, open areas, landmarks, surrounding roads/lanes/access etc.

Ground truthing has to be carried out along with the collection of attribute data for spatial features. The bidders will have to deliver the final outputs in CD-ROM media (should be readable under standard windows NT/2000 platform) and hard copy. Each of the activity will be followed by quality assurance checks by the RAY Technical Cell experts (city team) and the Municipal Corporation officials or SRSACs or the empanelled agency.

5.2.2 Objectives

The objectives of Mapping are:

1. Develop a common digital geo-referenced base map that will be used by all participating sections/departments within ULB for detailed mapping. This map is to be updated regularly to maintain an accurate and reliable information data base on properties and all components of infrastructure on a common, scalable and physically verifiable municipal GIS platform.

2. Establish the locations of property (building or plot) in slums onto the GIS base map and its corresponding data which would provide a spatial dimension of Properties.

3. Improve the coverage and provision of municipal services (eg. water and sewerage connections) through mapping of all existing infrastructure facilities onto the map.

4. Allow spatial analysis of service provision levels, revenue generation and social composition, particularly identifying the location of poor and socially excluded communities.

5.2.3 Description of Tasks

(a) Preparation of Geo-referenced City Base Map and Slum Mapping

This task is focused on the preparation of digital geo-referenced GIS base map for the town/city/agglomeration limits of the ULB. The Technical Consultant (TC) shall review all available maps (either print on paper or available soft copies), quality of available data and date(s) of acquisition as well as their scales. It is likely that the ULB may or may not have GIS base maps obtained from satellite imageries. In the absence of GIS maps, the TC shall procure such satellite images or maps from official sources (e,g., NRSC, State RSACs etc.) or other reliable sources. In case the ULBs have paper maps on a suitable scale, the TC may geo-reference it using GPS, as outlined in Section 2.2.4.

Total Station survey and/or other spatial survey will be used for slum mapping. The base map shall contain all key physical features, the boundaries of each plot or building (structure) and a plot or building identification number. The map shall be multipurpose and could be used by various sections of the ULB such as engineering, revenue (taxation) and town planning.

(b) Data Contents and Specifications

The preparation of geo-referenced city base map shall be based on high-resolution latest satellite imageries and DGPS. Slum mapping shall be done using Total Station Survey. To facilitate sharing of information between various municipal sections, it is critical that GIS base mapping be compatible with standard data base formats. The base map shall be prepared using various layers for ease of operation in GIS. Each layer shall include, but not be limited to, the following (Table 3):

Table 3: Data contents and specifications

Sl. No	Layers	Data contents and specifications
1	City /Town Base Map	- Refer to Section 2 detailed guidelines in the preparation of Base maps. - Major physical features, such as highways, roads, railways, important land marks (temples, mosques etc.), water bodies, canals, rivers etc; depicting right-of-way. - Municipal/agglomeration boundary, ward and zone boundary and slum boundary - The Technical Consultant will also mark the approximate boundaries of each slum in clear outlined location onto the municipal base map.
2	Slum Base Map	- Foot prints of each building (structure) and its use (residential, commercial etc.), number of levels (storeys), community centres, *anganwadis*, *balwadi* centres, community toilets, schools, health clinics/post offices and religious structures. - Structures related to garbage collection, boundary walls and fencing and other utilities, plinth level of each building structure. - Open (vacant) plots, play grounds, parks and gardens - Commercial and non-household based activity areas such as small factories and manufacturing units within the Municipal/agglomeration boundary and ward & zone boundaries.
3	Existing Infrastructure Both City Level and Slum Level (in various layers)	- Roads & footpaths (both *pucca* and *kutcha*), Parks, Playgrounds and Open spaces, all drains with direction of flow (in the case of larger drains, sections and levels), landmarks e.g, Places of Worship, Police Stations, Bus Stations etc; - Water supply pipelines, source works e.g., bore wells/ hand pumps etc. or municipal supply), public water stand-posts - Sewers, location of manholes (gutters) - Street lights, electric poles - Power and telecommunication lines / poles - Natural and man-made drainage channels - Elevations at all road junctions and turnings
4	Existing Offsite infrastructure (adjacent linked	- Urban Infrastructure e.g., Roads/lanes/access, drainage, sewerage, water and power (access roads, location of secondary

Sl. No	Layers	Data contents and specifications
	infrastructure) in case of Slum Mapping	water mains and information on any main drains running through the slum or to which the slum is connected. - Distances of slum to city wide services like access road, outfall drain, section of offsite drains and major culverts, disposal points and HFLs, diameters of pipes, ELSR/GLSR capacities and levels. - Diameters of trunk sewer, MH top and invert levels at junction with main sewer distance from the slum settlement and capacity of treatment facilities. Transformer (location and capacity) connection for street lighting. - Municipal Corporation boundary, ward and zone boundaries and slum boundary
5	Contours	- Contours at 0.5 meter interval. Spot levels at all junctions, changes in slope and at 30 meter intervals along all roads and lanes. - GTS Bench mark – Exact location, Reduced Level and notation - TBM – Exact location, Reduced Level and notation.

The creation of unique IDs for all buildings or structures in each slum shall be done in close consultation with the ULB Technical Cell. This is critical for proper representation of geographical data and location of each structure, which shall form part of GIS for the spatial analysis and will link property referencing for Unique Identification Authority of India. In the case of digitization, the data needs to be checked for accuracy, completeness, displacement, edge matching, symbology etc. All accuracy specifications as described by the implementing agency will have to be strictly adhered to. Adequate number of benchmarks shall be put and catalogued.

5.2.4 Quality assurance

In order to maintain the desired quality of mapping, it is required to assure the quality of work. In the case of preparation of city-level Base Maps using high resolution latest satellite imageries such as, Cartosat or Quickbird images, spatial accuracy needs to be maintained. In case of digitization and geo-referencing of paper maps of various components of infrastructure, the method to be adopted for digitization shall conform to the standards prescribed by the Survey of India and as outlined in the Section on 'Guidelines for the preparation of geo-referenced base maps'. In the case of digitization, the data needs to be checked for accuracy, completeness, displacement, edge matching, symbology etc The Base Maps should clearly show location of each slum – notified or otherwise. While superimposing infrastructure and utilities, care should be taken to achieve high accuracies on ground in conformity with the scale of mapping. For

example, If 1 m spatial resolution satellite images are used, the scale of thematic map should be 1:4,000 and RMS (Root Mean Square) error should be less than a pixel. However, the positional accuracies would be 2.0 m with respect to 0.5 mm mapping/ plotting accuracy of such maps. In special cases, an accuracy interval may be specified to prepare required maps in the first stage, which could further be improved on Quality evaluation and recommendations. These may be updated at a later stage by systematically carrying out checks covering each ward / zone with respect to each component – water supply, sewerage, storm water drainage, power transmission / distribution, telephone and similar utilities. Since each of them will be in separate layers, updating and verification by each department / agency should be practicable. The updated, corrected and verified layers can then be superimposed by the ULB or their TCs. This way, the ULBs will have a reliable and accurate data base, which can be updated at regular intervals and used by concerned departments / agencies, without any conflict, whether spatial or administrative.

In the case of Slum Mapping, it is required to assign IDs with names of each slum – whether notified or not. Unique IDs for all buildings or structures in each slum shall be done in close consultation with the ULB Technical Cell. This is critical for the inter-linking of (a) geographical data and location for each structure (which shall form part of GIS for the spatial analysis) and (b) Slum socio-economic data in a seamless manner. At a future date, these IDs may be utilized to be converted / linked with the IDs generated by the Unique Identification Authority of India.

In the case of maps being produced by Total Station Survey, the map scale is 1:500, and a plotting accuracy of 0.5 mm will be required, representing 0.25 m on the ground.

All accuracy specifications as stipulated by the implementing agency should be strictly adhered to. Adequate number of benchmarks (minimum 2 in each slum or 3 in a slum cluster) shall be established and catalogued.

The ULBs through its RAY Technical Cell experts (city team) and / or its designated officials or SRSACs: should carry out checks to ensure availability of the following:

- Index grid and inventory of the city cadastral sheets, as much as available.
- Inventory of the other maps like development plan, infrastructure/ facility/amenity maps with date(s) of production
- Clarity and readability of the scanned files.
- Correct mosaic
- Digitization accuracy
- Layers name in digitization and colour codes
- Topological accuracy
- Metadata for scanned files as per specification
- Correctness, mapping accuracy and consistency of the output produced with respect to the input maps

In addition, the designated cell / officials should co-ordinate between GIS Mapping team(s) and MIS and House Hold survey team(s) to ensure that proper integration of GIS and MIS interfaces are maintained.

5.2.4 Outputs and Deliverables

(a) For City-level Base Maps:

- Detailed Geo-referenced maps as described in the scope of work shall be produced both in digital form and hard copy(ies).
- City maps with various layers as per scope of work.

(b) For Slum Mapping:

- Detailed Geo-referenced maps as described in the scope of work for the selected slums – separate maps for each unit of the slum or cluster of slums shall be produced both in digital form and hard copy(ies).
- Slum maps with different layers (including cadastral information)

Hard copies shall be produced (preferably in A2 size sheets) at a scale of 1:500. The digital copy should have facility such that the printout of combination of layers may be taken as required.

The printed copies shall include standardised cartographic legends, bar scale, north sign, control points, sheet reference, date of survey, title and project logo. The standard Map Layout should be finalised in close consultation with the city level Technical Cell.

5.3 Working Arrangement

The assignment will be contracted by the ULB(s) to Technical Consultants / Survey firms or other para-statal organisations. Management of the assignment and all logistical, financial and methodological arrangements will be ensured by the ULB. The ULBs will ensure the support of municipal officials and other concerned agencies, where necessary through monitoring and output review committee or such other suitable arrangements.

(a) Items to be provided by the ULBs

The ULBs will:

- Provide a Senior officer in the rank of deputy commissioner or equivalent to liaise with the TC
- Brief the Consultant on the objectives, design, methodology and programme for the GIS mapping and survey

- Nominate officers to participate in a) survey work, b) database development and (c) GIS mapping; (d) making them available in the field to observe and oversee survey work and data verification.
- Provide timely advice to the Consultant concerning the work under the programme and slums for survey.
- Provide the TC with maps of survey areas, if available
- Provide the Consultant with necessary authorisation to procure the satellite data or maps of existing town area and the future expansion area (periphery or urban agglomeration area).
- Provide the TC with all necessary authorisation to undertake the surveys and field verification.
- Provide access to office space, if available.

(b) Items to be provided by the Technical Consultant

In addition to the results and deliverables listed above, the TC will provide:

- All materials (including satellite data) and equipment necessary for DGPS surveys, digitised base mapping
- All survey equipment and data entry staff
- All satellite data processing, field survey and data entry staff
- Organisation and orientation training to enable municipal staff to participate in the GIS base mapping preparation, survey and data entry, and to manipulate and produce reports from the databases.
- Arrange office equipments – Computers, software including software for satellite data processing.
- Arrange for all transportation and travelling required for their (TC's) own staff

5.4 Requirement of manpower for the Technical Consultant / Institute

Recommended qualifications and work experience of the personnel are outlined below:

S.No	Key Person	Minimum Qualifications	Minimum Work Experience
1.	Team Leader	Master in Social science / Urban planning/ Graduate in Civil/Municipal/ Environmental engineering	10 years experience in development sector with atleast 5 years of working experience in government projects. Knowledge in Urban planning and related fields like GIS, Remote Sensing etc is desirable.
2.	GIS / Remote Sensing Specialist	Graduate / PG Degree with certification in GIS from reputed organisations	5 years experience in managing or developing databases including data collection, entry and maintenance in essential. Strong practical experience in using Digital Image Processing and Geographic Information Systems (GIS) software tools is essential, For example: ESRI products such as ArcView, ArcGIS, ERDAS Imagine and other platforms Programming in GIS application development in desktop / web environment is desirable.
3.	Town/Urban Planner	Post graduate Degree in Urban Planning	5 years experience in planning with GIS expertise – master plan, area plan preparation and urban poverty related experience etc.

S.No	Key Person	Minimum Qualifications	Minimum Work Experience
4.	Municipal Engineer	Graduate Civil Engineer	5 years experience in design / construction / maintenance of light traffic roads, water supply, sewerage and drainage.
5.	Surveyor[2]	Diploma in Surveying	3 years experience in Topographic Surveying using Total Station Equipment.
6.	Draughtsman (Civil) [3]	Diploma in Civil Engineering./ITI (Civil) with Diploma in Computers	5 years relevant experience including AutoCAD drawings and MS Office proficiency.

5.5 Reporting and Timing – To be specified by ULBs while work allotment

Report for each slum or slum group	Suggested time period from starting date
Inception Report highlighting review of collected available maps and related data, identification of existing data gaps and proposal how to bridge data gaps, detailed work programme	__weeks
Draft City base map	__weeks
Slum Map(s), including infrastructure provision / availability of off-site services as applicable	__weeks
Final City base map Including Final Slum Map(s) and Report based on the TOR including Analysis & GIS-MIS integration.	__weeks

Please refer to Annexure VII for Illustrative Bid Document.

[2] No of surveyors will depend on the size of the slum and number of slums to be taken up

[3] No of draughtsman will depend on the size of the slum and number of slums to be taken up

6.0 Specifications for procurement of Hardware & Software

The requirement of the hardware and software for the implementation of the project depends on the option chosen by the States and ULBs.

6.1 Option – 1

6.1.1 State level hardware and software requirements

Using Web based application of 'MIS for Surveys' which can be accessed at http://surveys.cgg.gov.in

Desktop Computer with the following configuration:

- Intel Core i5/ i7 -750 Processor (2.66GHz, turbo up to 3.2GHz, 1333MHz FSB, 8MB Cache) or better
- Intel H 57 or higher chipset
- 4GB or higher RAM
- 500 GB SATA hard disk
- 16 X DVD RW drive
- HDMI/DVI support for better graphics
- 20" LCD monitor with HDMI/DVI support
- Integrated high definition Audio
- Integrated Video/ graphic card with minimum 1 GB RAM with support for HDMI/DVI
- Standard Keyboard and optical mouse

Internet Bandwidth

- At least 2 Mbps broadband internet connectivity (Note: 1 Mbps bandwidth is sufficient for 4-6 concurrent users)

Software requirement

- Windows/ Linux operating system with any internet browser
- Any standard GIS Software including Open Source Products (refer Annexure XI)

6.1.2 City level hardware and software requirements

Hardware requirements: Desktop Computer with the following configuration:

- Intel Core i5 / i7-750 Processor (2.66GHz, turbo up to 3.2GHz, 1333MHz FSB, 8MB Cache) or better

- Intel H 57 or higher chipset
- 4GB or higher RAM
- 500 GB SATA hard disk
- 16 X DVD RW drive
- HDMI/DVI support for better graphics
- 20'' LCD monitor with HDMI/DVI support
- Integrated high definition Audio
- Integrated Video / graphic card with minimum 1 GB RAM with support for HDMI/DVI
- Standard Keyboard and optical mouse

Internet Bandwidth – 2 Mbps broadband internet connectivity (Note 1 Mbps bandwidth is sufficient for 4-6 concurrent users; Number of desktops may be increased depending on the data entry requirements)

Software requirement

- Windows/ Linux operating system with any internet browser
- Any standard GIS Software including open source product (refer Annexure XI)

6.2 Option – 2

Use of any offline tool for data entry at City level. It is assumed that the data entry takes place at the city level alone and the States will only be accessing the online tool to review and monitor the progress.

6.2.1 City level

Hardware requirements: Desktop Computer with the following configuration

- Two CPU capable server fully loaded.
- Intel(R) Xeon(R) X3450 Processor (2.66GHz, 8M Cache Turbo, HT) or higher.
- 32 GB RAM or higher.
- 300 GB X 6 SAS disks or higher.
- Raid Controller Card with 512 MB cache or higher.
- 2 numbers of Gigabit Ethernet ports or higher.
- Tower chassis
- 17" monitor
- 104 key standard keyboard, optical mouse
- Redundant power supply
- 16X SATA DVD RW or higher

- 80/160 GB DAT drive.
- 3yrs comprehensive onsite support from vendor.

Desktop Computer with the following configuration:

- Intel Core i5/ i7-750 Processor (2.66GHz, turbo up to 3.2GHz, 1333MHz FSB, 8MB Cache) or better
- Intel H 57 or higher chipset
- 4GB or higher RAM
- 500 GB SATA hard disk
- 16 X DVD RW drive
- HDMI/DVI support for better graphics
- 20'' LCD monitor with HDMI/DVI support
- Integrated high definition Audio
- Integrated Video with minimum 1 GB RAM with support for HDMI/DVI
- Standard Keyboard and optical mouse

Internet Bandwidth: 2 Mbps broadband internet connectivity (Note: Mbps bandwidth is sufficient for 4-6 concurrent users; Number of desktops may be increased depending on the data entry requirement).

- LAN connectivity: LAN connectivity to be established for the necessary no. of desktop computers with the server using network switch with appropriate number of ports.

Software requirement

- Windows/ Linux operating system with any internet browser for the desktops
- Linux operating system configured with tomcat web server and postgresql database for the server system.
- Any standard GIS package including open source product (refer Annexure XI)

7.0 List of National and Regional Resource Centres for undertaking capacity building in different components of RAY

S. No.	Name of the resource centre
National Resource Centres	
1.	National Remote Sensing Centre (NRSC/ ISRO), Hyderabad and its Regional Centres located at Dehradun, Kharagpur, Nagpur, Jodhpur and Bangalore
2.	Survey of India / Indian Institute of Surveying and Mapping, Hyderabad

3.	Indian Institute of Remote Sensing, Dehradun
4.	Centre for Good Governance (CGG), Hyderabad
State/ Regional Resource Centres	
1.	North Eastern Space Application Centre, Shillong
2.	State Remote Sensing Application Centres of various states (BISAC, Ahmedabad, MRSAC, Nagpur, APSRAC, Hyderabad) and other partner institutes

The list of empanelled agencies is given in Annexure IX

Detailed Contact Address of State remote Sensing Centres are given in Annexure XII

8.0. Training modules for MIS, GIS (including Remote sensing) and Total Station

S. No.	MIS & MIS integration with GIS – Modules	User	Component
1	Module -1 1. Orientation on MIS. 2. Exposure to the technology options available for MIS implementation	Commissioners/ First level officials	Training
2	Module -2 1. Orientation to the e-tool to understand the data entry level needs 2. Hands on session	MIS specialists/Project officers	Training
3	Module -3 1. Porting of the offline tool 2. Exporting data (in the form of .sql, .mdb etc) from offline tool to online MIS	System Administrators	Training
4	Module -4 1. Preparation of Data for integration into GIS 2. Illustration of integration methodology	GIS and MIS specialists	Training

S.No.	GIS – Modules	User	Component
1	Module -1 1. Basics of Remote Sensing 2. Introduction to Remote Sensing analytical software	Commissioners/ First level officials	Training
2	Module -2 1. GIS Based query and Analysis 2. Building Information Systems	GIS specialists/Project officers	Training

3	Module -3 1. Web based Solutions both on Desktop and Network based Applications. 2. Operational software, open source and IGIS developed by ISRO	System Administrators & GIS specialists	Training

NRSC, Hyderabad would involve SOI (nodal Centre for Total Station survey and large scale mapping), CGG (Nodal Centre for Slum MIS) for designing the course content, duration and scheduling of organizing the training programmes.

9.0 Summary

Rajiv Awas Yojana (RAY) basically addresses the aim of make our cities slum-free. This means, the existing slums in various cities in the country need to be re-developed through a participatory process and convincing the slum dwellers about better way of living and cleanliness etc. Each slum will have to be temporarily rehabilitated, new developmental plans prepared, the plans to be implemented and finally the slum dwellers to be brought back to their own place at the end. This entire process calls for a detailed design, planning and implementation in a systematic manner. Hence, the project has decided to use technology as a means to find appropriate and accurate solution in a shorter time. A combination of high spatial resolution satellite data, GIS, GPS, MIS and other technologies are envisaged to be used for optimal solution.

This document has covered various aspects related to RAY project implementation, with respect to the baseline data creation, field surveys, identification of slums, different scales of mapping of city/ township and slums, relevance of MIS as a solution for the project database and for monitoring, remote sensing data as spatial input for geospatial database creation, details on GIS database creation and usage under the project. At different stages in the document, elaborate information is provided on how to create GIS databases using different methods. Specific reference is made to the preparation of base layer, again with respect to different scale, at 1:50,000 (SOI open series as reference), 1:5000 and 1:500 scales, respectively. Modalities of such database creation at large scales using combinations of satellite imageries, GPS based field surveys and total station survey methods also have been elaborated. Typical differences between CAD drawings and GIS layers, with particular reference to map projections are also addressed. An elaborate section is dedicated to how data can be collected online through a web enabled solution for not only baseline creation but also for concurrent monitoring of the project is also well thought of under the project by adopting a solution as a combination of MIS and GIS. The software design aspects and database related details are also addressed under the MIS and GIS solutions in addition to the synergy of using MIS/GIS as a combination.

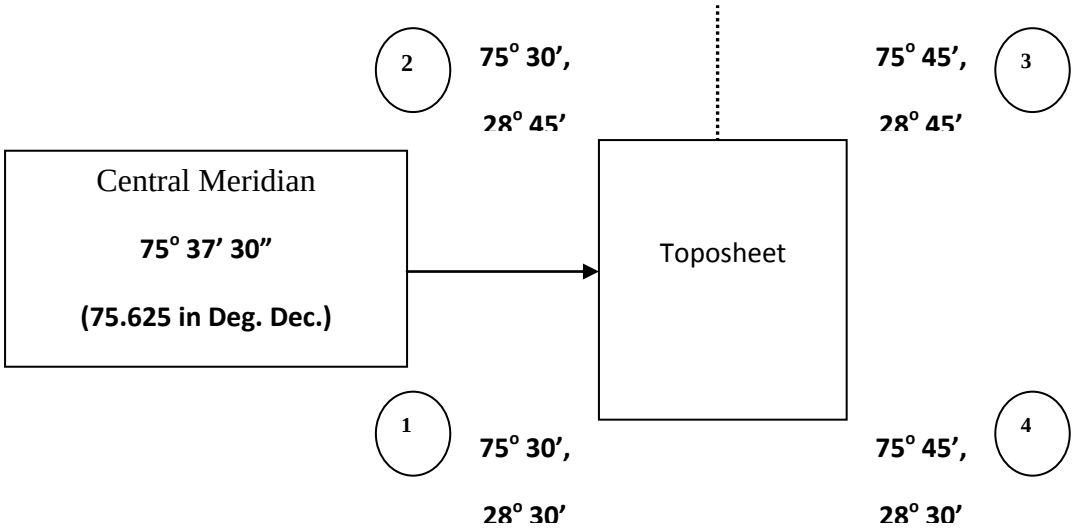
Annexure I

Illustrative examples for using paper maps for GIS

a. Illustrative example of Georeferencing of paper maps

Identification of Ground Control Points (GCPs) on existing maps:

A set of GCPs could be identified on maps such as four corners of a Toposheet (not limiting only to 4 corner points), which provides information of latitudes and longitudes at the four corners. For better results, additional known control points could be identified and mapped. These points should ideally be spread over the entire map. In the following example, the longitudes and latitudes of four corners are as indicated (For the sake of understanding, geo-referencing procedure is illustrated for only four corners points of a toposheets).



Values in Degree Minutes Seconds need to be converted into Degree Decimals. The four points would have following values respectively for points marked (1) to (4) –

Longitude	Latitude
75.5	28.5
75.5	28.75
75.75	28.75
75.75	28.5

Prepare a table as shown above for the GCPs in **.dbf** format. (Such a table could be prepared in MS Excel and saved as a Dbase table). This table could be named as **GCP.dbf,** which would be used for registration of the scanned toposheet. The step-by-step guide is given below of using ArcGIS georeferencing tool as an example.

Creating a Master GCP layer:

1. Open ArcMap. From the "View" menu chose "Data Frame Properties". The Data Frame Properties window opens. It shows the Co-ordinate System Tab indicating "No projection" in "Current Co-ordinate System". Co-ordinate system for the map needs to be specified.

2. Click on "New" button to choose "Projected Co-ordinate System". A window for "New Projected Co-ordinate System" opens. Specify a name for the new co-ordinate system such as "My Projection". In the projection frame – chose "UTM" from the drop-down list.

3. The remaining parameters of False Easting, False Northing, Central Meridian and Latitude of origin need to be specified, based on the extent of map. For this, we would take reference of Lat-Long values that we have used.

4. For example, following values will be considered as parameters

   - False Easting – 0.0
   - False Northing - 0.0
   - Central Meridian - 75.625 (Central meridian of the Toposheet)
   - Latitude of origin - 0.0

5. In the Geographic Projection System area, Click "Select" button. This opens the "Browse for Co-ordinate System" dialog. Double-click on "Spheroid Based" folder. From the available list, chose "WGS84.prj". Click "Ok" on all the co-ordinate system windows. This would apply the specified projection and geographic co-ordinate system parameters to the "Data Frame". Also, from the "General" tab, change the display units from "meters" to "Degree; Minutes; Seconds". Click "Apply" and then "Ok" on the "Data Frame Properties" window.

6. Go to the main menu bar in ArcMap. Select "Tools" and then chose "Add X- Y Data". A window for "Add X-Y Data" opens. From this "Chose a table from the map or browse for another table" option, click on the button having an icon resembling "open folder" icon. Chose the appropriate location where your **GCP.dbf** table (created in step 2) is stored. Once the table name is selected, the fields of Longitude

and Latitude are automatically picked up for X-Field and Y-Field. Do not select any spatial reference at this stage. Click "Ok" on the "Add X-Y Data" window. The system processes and adds a layer in Table of Contents and shows the four points on the display area. Thus, control points are established with the specified co-ordinate system.

7. Right click on the layer name in the Table of Contents, chose "Data" from the context menu and chose "Export Data". (This would help to export this layer as a new shapefile). You are asked by the software to opt between two options, which are –
   - Use the same co-ordinate system as this layer's source data and
   - Use the same co-ordinate system as the Data Frame.

8. Select the second option and specify an output shapefile name such as "Projected_GCP.shp". You can use this projected shapefile for assigning spatial reference information properties to other image file or vector files (Do not close ArcMap at this stage).

9. Go to ArcMap and add this image file. At first, the image file will not be seen in the display area. Now, go to the "View" Menu and select Toolbars > Georeferencing.

10. From the Georeferencing toolbar, make sure that "Auto Adjust" is un-selected.

11. From the same toolbar, click on "Fit to Display". This would show the image file on the display area. Now, the image as well as control points will be visible. Using "add control points button" on "georeferencing" toolbar, links between points on the toposheet image and the control points can be added. When all the links have been established, select "Update Display" from the "georeferencing" toolbar.

12. This would register the image with GCPs. Now, select the "View Link Table" button from the "georeferencing" toolbar, RMS error in the form of "Residual" will appear. If the RMS error is within acceptable limits select "Auto Adjust".

13. Following images present an illustration of how a map is scanned and geo-referenced.

    Figure 3 below shows a scanned map. After the image is set to match the projection of the base map, the scanned image would be appropriately positioned aligning with the base map with appropriate x, y coordinates as shown in Figure 4.

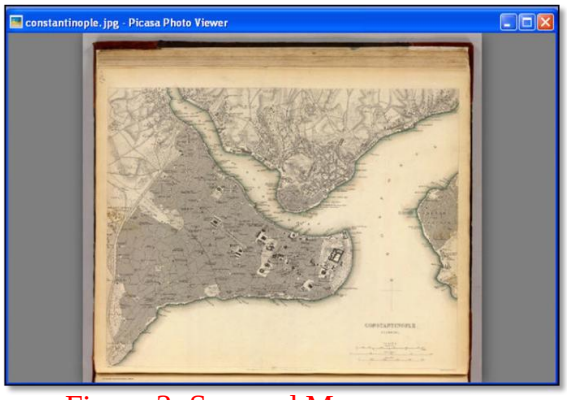


Figure 3: Scanned Map

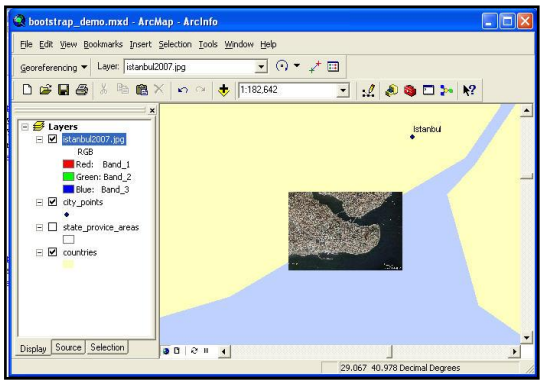


Figure 4: Projected Scanned Image

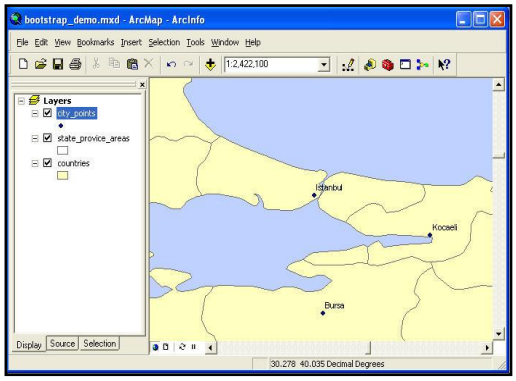


Figure 5: Identifying and fixing control Points

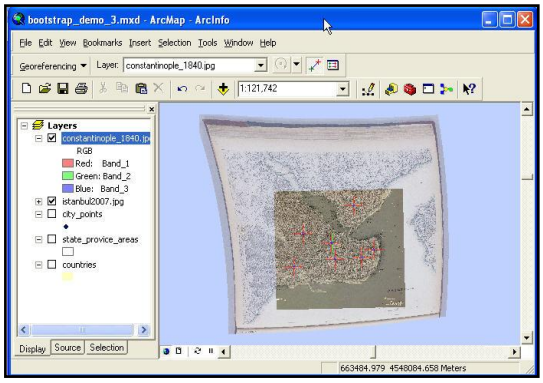


Figure 6: Creating polygons using Control points

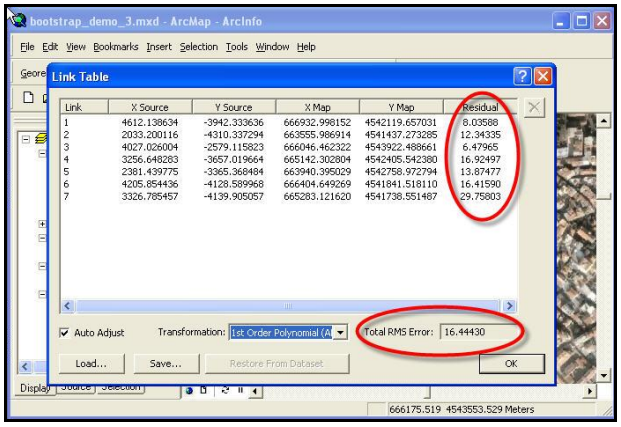


Figure 7: Populating fields

Based on the feature of interest, multiple coordinates could be digitized and hence, polygons can be drawn (Figure 7). The attribute table of the polygon will have to be then populated with information pertaining to the polygon. For instance, if a slum is digitized from the map, information on land ownership, dimensions of the structure and any relevant information need to be populated under individual fields. An example of populating fields is shown in Figure 4 above. Each polygon would also have a unique identification number.

b. Illustrative procedure of digitizing CAD based paper maps or toposheets

If there are CAD based paper maps available, those maps can also be digitized using the procedure explained above. A ULB will be able to convert a CAD file with necessary geo-coordinates to a GIS vector file format (shape file). Following figures (Figure 8 to 12) are an illustration of how CAD based maps could be digitized.

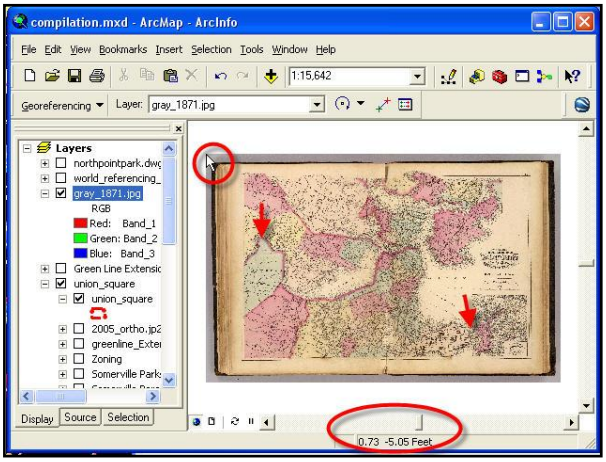


Figure 8: Scanned Image

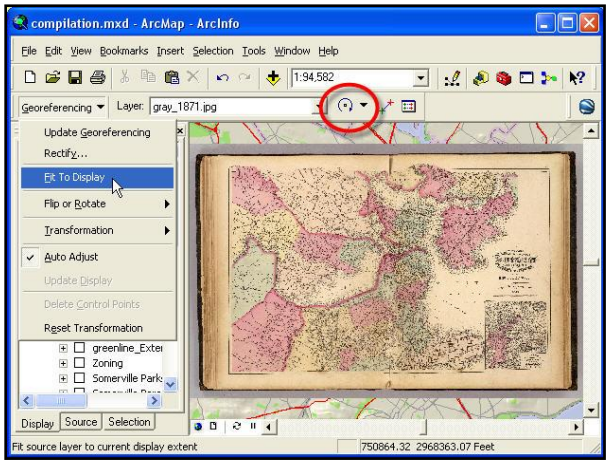


Figure 9: Activate geo-reference tool (red circle)

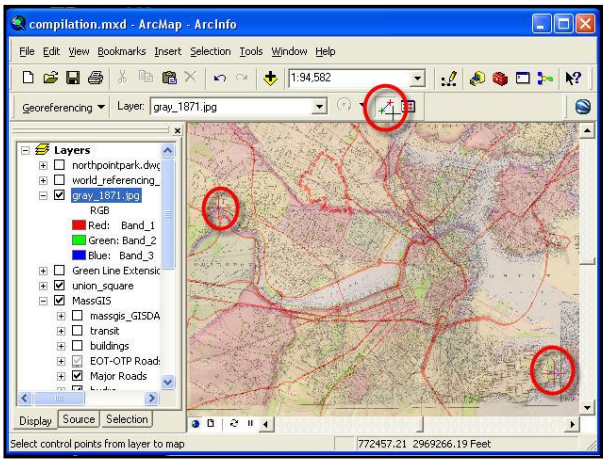


Figure 10: Set Control points as shown

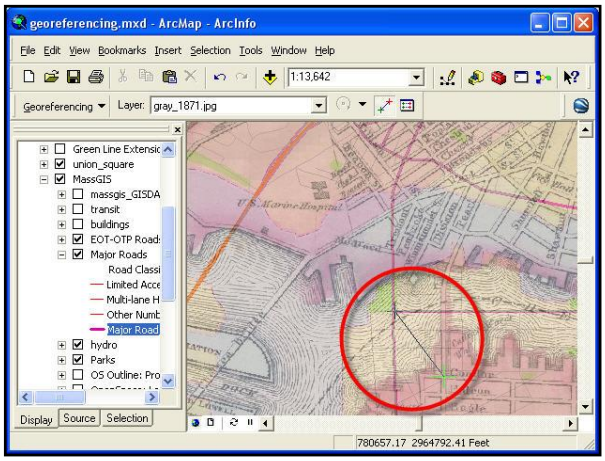


Figure 11: Setting up additional control points

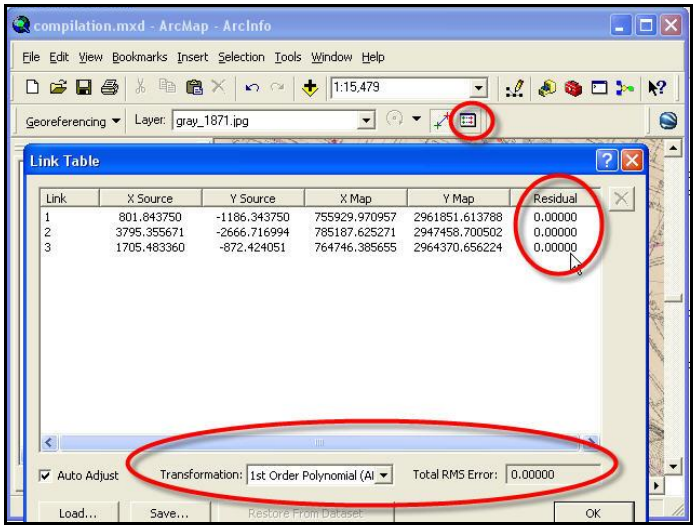


Figure 12: Populating the attribute table of line shape file

After digitizing the scanned map and vectorisation with associated attributes, a separate layer will be created with appropriate title as shape file. Along with the city base map and other infrastructure layers such as roads, sewer and other permanent feature shape files, the newly created layer would also be brought into the user interface on the screen as required. This layer, as with other layers could be activated and de-activated depending on the need.

Annexure II

Illustrative Data layers to be created for various utilities

Source: YASHADA

S.NO	FEATURE CLASS	FEATURES REQUIRED
1.	Road	• Major, minor road network • Road intersections • Carriage way • Footpath
2.	Water Pipelines	• Pipeline Distribution network • Pumping stations • Overhead tanks • Water treatment plant • Reservoir overhead/underground • Balancing tanks • Bore holes • Water supply office locations • Location of valves • Fire hydrant locations • Consumer indexing with property no • Public taps
3.	Electric lines	• Electric feeders • Electric sub stations • Electric poles • Transformers • Low tension lines • Jurisdiction of SDO • Consumer indexing • Street lighting network and spacing of street lights • Location of street light pole
4.	Sewer pipeline	• Sewer pipe network • Pipe segments • Joints • Manholes
5.	Storm water drain	• Storm water drain network • Width of drain
6.	Traffic management	• Traffic control room • Traffic light network • Traffic signal post • Public parking • Bus stop • Traffic congestion areas • Petrol pump • Ambulance service locations

S.NO	FEATURE CLASS	FEATURES REQUIRED
7.	Health care	• Hospital location • Dispensaries • PHCs • Chemist shop location
8.	Fire services	• Fire station location • Area jurisdiction for each fire station • Fire prone areas
9.	Telecommunication network	• Telephone exchange • Telephone pole • Telephone cables along road • Distribution point

Note: Depending on map scale (1:5000 or 1:10000) chosen for the city base map, some of the above features that are not visible at the mentioned scale can be omitted.

Annexure III

Illustrative Attributes required for different layers[4]

S.No	Feature Class	Attributes
1.	Road	Object ID, from, to, Category – National Highway, State highway, major road, minor road, lane, slum road type- concrete, tar, WBM, kaccha. Length, right f way, carriageway, pavement surface, storm drain, number of lances Footpath: Object ID, Type, width, length etc
2.	Water pipelines	Object ID, pipe dimensions, flow direction, Pressure, Details of valves, segment number, segment length, joint type, pipe material, depth below ground level, consumer attribute details: object ID, customer ID, customer name, last bill amount and paid date
3.	Electric lines	Feeders: object ID, feeder ID, LT Ckt code, Section of LT, conductor size and length. Distribution transformers of 11 kv or less – capacity, voltage ratio, manufacturer, manufacture serial no, year of manufacture, date of commissioning, meter no, meter type. Consumer indexing: consumer name, father's name, consumer code, date of connection, pole no of LT mains to which connected, service connection no. Meter details: meter no, type, make, year of manufacture, seal on meter body.
4.	Sewer pipeline	Object ID, flow type, diameter, material, month installed, date installed, joint type, last maintenance date, manhole ID, manhole cover type, manhole levels (G.L/I.L).
5.	Storm water drain	Object ID, type, width, length, location, flow direction, last maintenance, etc.
6.	Traffic management	Intersection ID, volume of traffic at the point, peak hours
7.	Street light	Object ID, bulb type, pole type, pole number, location, electric loop wise grouping, height of pole, installation data, cost, date of last maintenance (paint, bulb change etc) maintained by.
8.	Health care system	Object ID, no of doctors, specialists, number of beds available, telephone number, address
9.	Fire service	Station ID, no of fire engines available, specialized equipment availability, ladders, no of fire proof jackets available, total staff, available staff at any given time, telephone number, address etc.
10.	Telecommunications network	Object ID, exchange ,cable type, depth below ground level, last digging permission given to BSNL etc.

Note: Depending on map scale (1:5000 or 1:10000) chosen for the city base map, some of the above features that are not visible at the mentioned scale can be omitted.

[4] (YASHADA 2008)

Annexure IV

Coding System[5] for various features in the process of slum survey

SNo.	Level	LAYER NAME	Description	Type	CODEPAT	CODEAAT
A		**BOUNDARY**				
1		MAPBOUNDARY_NET	Map boundary box	net	1000	1000
2		**MUNICIPAL_NET**	**Municipal Boundary**	**net**	**1001**	**1001**
3		CITY_NET	City Boundary	net	1002	1002
4		CITY_NET	Mouza boundary	net	1003	1003
5		CANTONMENT_NET	Cantonment boundary	net	1004	1004
6		ZONE_NET	Zone boundary	net	1005	1005
7		PRABHAGSAMITI_NET	Prabhag samiti boundary	net	1006	1006
8		PRABHAG_NET	Prabhag boundary	net	1007	1007
9		WARD_NET	Ward boundary	net	1008	1008
10		LOCALITY_NET	Locality, Peth, Colony, Mohalla boundary	net	1009	1009
11		**REVENUESURVEY_NET**	**Revenue Survey Boundary**	**net**	**1010**	**1010**
12		**CITYSURVEY_NET**	**City Survey Boundary**	**net**	**1011**	**1011**
13		RIVISIONSURVEY_NET	Rivision Survey Boundary	net	1012	1012
14		HISSA_NET	Hissa boundary	net	1013	1013
15		INAMREVISION_NET	Inam Revision Boundary	net	1014	1014
16		NABOUNDARY_NET	Non Agriculture area boundary	net	1015	1015
17		PLOT_NET	Individual Plot boundary	net	1016	1016
18		GAOTHANPARDE_NET	Gaothan Parde Boundary	Net	1017	1017
19		GAOTHAN_NET	Gaothan Boundary	Net	1018	1018
20		**ENCROACHMENT_NET**	**Encroachment Boundary**	**Net**	**1019**	**1019**
B		**TRANSPORT**				
1		EXPRESS_NET	Express Highway	net	2001	2001
2		EXPCL_LINE	EH Center Line	Line		2002
3		RING_NET	Ring Road	net	2003	2003
4		RINGCL_LINE	Ring Road Center line	Line		2004
5		BYPASS_NET	Bypass Road	net	2005	2005
6		BYPASSCL_LINE	Bypass Road Center line	Line		2006
7		LINK_NET	Link Road	net	2007	2007
8		LINKCL_LINE	Link Road Center line	Line	2008	2008
9		SERVICE_NET	Service Road	net	2009	2009
10		SERVICECL_LINE	Service Road Center line	Line		2010
11		ROADNH_NET	National highway	net	2011	2011
12		ROADNHCL_LINE	NH Center Line	Line		2012
13		ROADSH_NET	State highway	net	2013	2013
14		ROADSHCL_LINE	SH Center Line	Line		2014
15		ROADDR_NET	District Road	net	2015	2015
16		ROADDRCL_LINE	DR Center Line	Line		2016
17		ROADCITY_NET	Other City Roads	net	2017	2017
18		ROADCTYCL_LINE	Center Line of City roads	Line		2018
19		ROADSTRT_NET	Streets , Bylanes	net	2019	2019
20		ROADSTRTCL_LINE	Center Line Street bylanes	Line		2020
21		ROADFLY_NET	Fly over	net	2021	2021

[5] **Source: MRSAC, Nagpur**

SNo.	Level	LAYER NAME	Description	Type	CODEPAT	CODEAAT
22		ROADFLYCL_LINE	Center line Flyover	Line		2022
23		ROADOVRBRG_NET	Over Bridge over existing railway	net	2023	2023
24		ROADSUBWAY_NET	Subway below road or ground	net	2024	2024
25		ROADPWAY_LINE	Pathway (foot Path)	Line		2025
26		RDDIVIDER_NET	Road Divider	net	2026	2026
27		BRIDGE_NET	Bridge over River	net	2027	2027
28		CULVERTS_NET	Culverts on streams	net	2028	2028
29		RAILPROPERTY_NET	Area under Railway Property	net	2029	2029
30		RAILBG_NET	Railway tracks- broad gauge	net	2030	2030
31		RAILMG_NET	Railway tracks- meter gauge	net	2031	2031
32		RAILNG_NET	Railway tracks- narrow gauge	net	2032	2032
33		RAILYARD_NET	Railway Yard	net	2033	2033
34		RAILOVRBGD_NET	Railway over bridge	net	2034	2034
35		RLYSTN_NET	Railway Station	net	2035	2035
36		LINE_RLYSHED	Railway Shed	line		2036
37		AIRPORT_NET	Airport land property	net	2037	2037
38		RUNWY_NET	Runway	net	2038	2038
39		AIR_TERM_NET	Airport terminus	net	2039	2039
40		AIRHANGER_NET	Aeroplane Hanger	net	2040	2040
41		SEAPORT_NET	Marine Port	net	2041	2041
42		JETTY_NET	Jetties	net	2042	2042
43		BUSST_NET	Bus station	net	2043	2043
44		BUSAGAR_NET	BUS Agar	net	2044	2044
45		TRUCKST_NET	Truck Terminus	net	2045	2045
46		TXYSTD_NET	Taxi stand	net	2046	2046
47		PRKSP_NET	Parking lot	net	2047	2047
48		TRFCISLD_NET	Trafic islands	net	2048	2048
49		HAUD_NET	Small water tank	net	2049	2049
C		**UTILITY**				
1		WTPIPELINE_LINE	Water Pipeline	Line		3001
2		GSPIPELINE_LINE	Gas Pipeline	Line		3002
3		LTLINE_LINE	Low tension transmission line	Line		3003
4		HTLINE_LINE	High tension transmission line	Line		3004
5		POWERTRMUG_LINE	Power transmission line - Underground	Line		3005
6		ELECTSUBSTN_NET	Electrical Substation	net	3006	3006
7		BARRAGE_LINE	Dam/ barrage/ embankment	Line		3007
8		STRMDRN_LINE	Storm Drain, represented by single line on the map	Line		3008
9		SEWEROPEN_LINE	Sewer Line open, represented by single line on the map	Line		3009
10		SEWERCOVERED_LINE	Sewer line covered, represented by single line on the map	Line		3010
11		SEWERPIPE_LINE	Sewer pipe line, represented by single line on the map	Line		3011
12		NALLAOPEN_LINE	Open Nalla written on map, represented by single line on the map	Line		3012
13		NALLACOVERED_LINE	Covered Nalla written on map, represented by single line on the map	Line		3013
14		DRAINAGEOPEN_LINE	Open Drainage, represented by	Line		3014

SNo.	Level	LAYER NAME	Description	Type	CODEPAT	CODEAAT
			single line on the map			
15		DRAINAGECOVERED_LINE	Covered Drainage, represented by single line on the map	Line		3015
16		SEWEROPEN_NET	Polygon of Sewer Line open, represented by single line on the map	net	3016	3016
17		SEWERCOVERED_NET	Polygon of Sewer line covered, represented by single line on the map	net	3017	3017
18		SEWERPIPE_NET	Polygon of Sewer pipe line, represented by single line on the map	net	3018	3018
19		NALLAOPEN_NET	Polygon of Open Nalla written on map, represented by single line on the map	net	3019	3019
20		NALLACOVERED_NET	Polygon of Covered Nalla written on map, represented by single line on the map	net	3020	3020
21		DRAINAGEOPEN_NET	Polygon of Open Drainage, represented by single line on the map	net	3021	3021
22		DRAINAGECOVERED_NET	Polygon of Covered Drainage, represented by single line on the map	net	3022	3022
23		SYM_TOWER_TEL	Telephone tower	Point	3023	
24		SYM_PWR_ST	Power Station, MSEB	Point	3024	
25		SYM_TRNFRMR	Transformer	Point	3025	
26		SYM_TRANSMISSIONTOWER	Transmission tower	Point	3026	
27		SYM_TEL_EXN	Telephone Exchange	Point	3027	
28		SYM_WRLS_ST	Wireless Station	Point	3028	
29		SYM_MOBILETOWER	Mobile telephone tower	Point	3029	
30		SYM_POL_ST	Police Station	Point	3030	
31		SYM_POL_CH	Police Chowki	Point	3031	
32		SYM_HOSPITALS	Dispensary/hospital/ clinic	Point	3032	
33		SYM_PATH_LAB	Pathological laboratory	Point	3033	
34		SYM_BLOOD_BNK	Blood Bank	Point	3034	
35		SYM_OFFICE	All Govt. offices	Point	3035	
37		SYM_MANHL	Manhole	Point	3037	
38		SYM_BANK	Bank	Point	3038	
39		SYM_ATM	Automatic Teller Machine	Point	3039	
40		SYM_RESTHS	Rest house/Circuit house	Point	3040	
41		SYM_PUBTOLT	Public Toilets	Point	3041	
42		SYM_PUBURNLS	Public Urinals	Point	3042	
43		SYM_FOUNTN	Fountains	Point	3043	
44		SYM_STATUE	Statue	Point	3044	
45		SYM_PUBTAP	Public Taps	Point	3045	
46		SYM_VEGMRKT	Vegetable Market	Point	3046	
47		SYM_MARKET	Market	Point	3047	
48		SYM_SLAUGHTER	Slaughter House	Point	3048	
49		SYM_KBRSTN	Kabrasthan	Point	3049	
50		SYM_GRVYRD	Grave Yard	Point	3050	
51		SYM_CRMTRM	Crematorium	Point	3051	

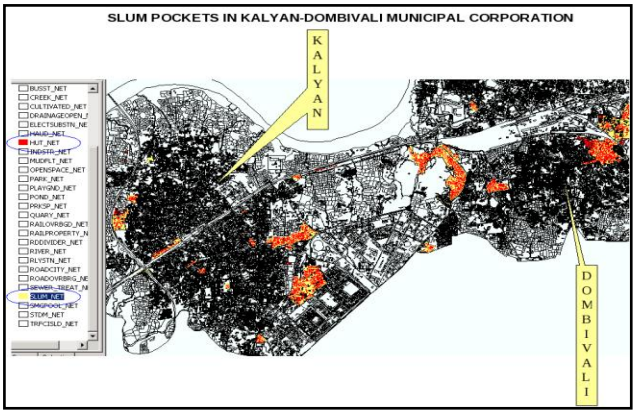
SNo.	Level	LAYER NAME	Description	Type	CODEPAT	CODEAAT
52		SYM_TFCSIG	Trafic Signal	Point	3052	
53		SYM_TFCBOOTH	Trafic Police Booth	Point	3053	
54		SYM_WELL	Well	Point	3054	
55		SYM_OVRHDTNK	Over head Tanks	Point	3055	
56		SYM_GRNDTNK	Ground level tanks	Point	3056	
57		SYM_GATE	Gates on Fence, Boundary, Building, CompoundWall, etc	Point	3057	
58		SYM_LAMPPOST	Lamp Post	Point	3058	
70		SYM_POLEELE	Electric Pole	Point	3059	
71		SYM_POLETELE	Telephone Pole	Point	3060	
59		SYM_FLOORMILL	Floor Mill	Point	3061	
61		SYM_FLAG	Flag, Flag Post, Flag Podium, etc	Point	3062	
62		SYM_PMPHS	Pump House	Point	3063	
63		SYM_COURT	Court	Point	3064	
64		SYM_DHARMASHALA	Dharmashala	Point	3065	
65		SYM_MALL	Mall	Point	3066	
66		SYM_MULTIPLEX	Multiplex	Point	3067	
67		Sym_PETROLPUMP	Petrol pump	Point	3068	
68		Sym_FIRESTATION	Fire Station	Point	3069	
69		Sym_LETTERBOX	Letter Box	Point	3070	
D		**SURVEY**				
1		TRAVERSESTATION_LINE	Line joining traverse station	Line		4001
2		THEODOLITE_LINE	Theodolite Survey line	Line		4002
3		PLAINTABLE_LINE	Plain table Survey lines	Line		4003
4		CHAINSURVEY_LINE	Chain Survey lines	Line		4004
5		SYM_ARROW	Arrows Without dimensions on River, Road, Nala, canal, etc.	Point	4005	
6		SYM_STONECIRCULAR	Circular Stone of Survey (Plain Table, Theodolite, Chain Survey, etc).	Point	4006	
7		SYM_STONESQUARE	Square Stone of Survey (Plain Table, Theodolite, Chain Survey, etc).	Point	4007	
8		SYM_STONEOTHER	Stone of Survey (Plain Table, Theodolite, Chain Survey, etc) Other than above.	Point	4008	
9		SYM_TRAVERSESTN	Traverse Station Point	Point	4009	
10		SYM_THEODOLITE	Theodolite Survey Point	Point	4010	
E		**BUILT UP**				
1		SHED_LINE	Shed line	line		5001
		FENCE_NET	Fence as boundary	net	5002	5002
2		FENCE_LINE	Fence	line		5003
3		WIREFENCE_LINE	Wired Fence	line		5004
		GATE_NET	Gates on fence, boundary, buildings, compound wall, etc.	net	5005	5005
4		FOUNTAINCANAL_LINE	Fountain	line		5006
5		BUILDING_NET	Building	net	5007	5007
		BUILDING_LINE	Building Line			5008
6		BUILDINGPROPOSED_NET	Proposed Building	net	5009	5009
7		BLDGOPENSPACE_NET	Open spaces in the building, courtyard, etc.	net	5010	5010

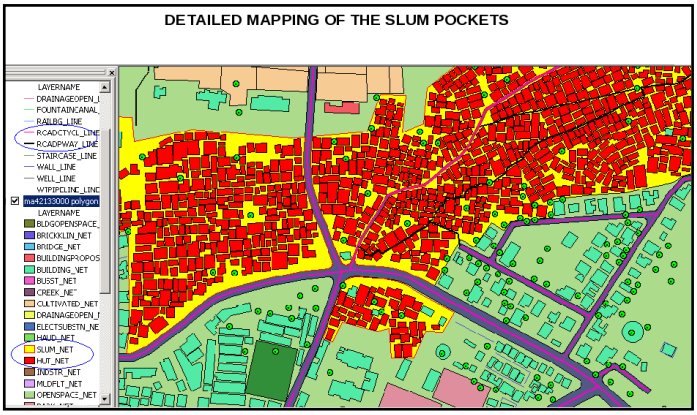
SNo.	Level	LAYER NAME	Description	Type	CODEPAT	CODEAAT
8		INDSTR_NET	Industry	net	5011	5011
9		STAIRCASE_LINE	Staircase Hatch	line		5012
10		**SLUM_NET**	**Slum area**	**net**	**5013**	**5013**
11		GAOTHAN_NET	Village settlement	net	5014	5014
12		SYM_JAIL	Prison	Point	5015	
13		SYM_HISTORICAL	Historical place	Point	5016	
14		SYM_MUSEUM	Museum	Point	5017	
15		SYM_OCTROINK	Octroi Naka	Point	5018	
		COMMON_WALL_NET	Wall having common possession	Net	5019	5019
		SEP_OWN_WALL_NET	Owners separate wall	Net	5020	5020
		OWN_WALL_NET	Owners wall	Net	5021	5021
		DOOR_LINE	All types of door (Shop , garage door etc.)	Line		5022
		GATE_NET	Gate	Net	5023	5023
		GATE_LINE	Gate	Line		5023
		VAHARANDA_LINE	Verandah	Line		5024
		HUT_NET	**Huts**	**Net**	**5025**	**5025**
F		**LAND USE / LAND COVER (URBAN)**				
1		CULTIVATED_NET	Agriculture land	net	6001	6001
2		FOREST_BND_NET	Forest land	net	6002	6002
3		PLANTATION_NET	Plantations	net	6003	6003
4		TREECVR_NET	Group of Trees	net	6004	6004
5		SCRUBS_NET	Shrubs	net	6005	6005
6		HABIT_VEG_NET	Habitation with vegetaion	net	6006	6006
7		CANAL_NET	Irrigation Canal	net	6007	6007
8		DRAIN_NET	Double line drainage	net	6008	6008
9		DRAIN_LINE	Single line drainage	line		6009
10		RIVER_NET	Polygon of river	net	6010	6010
11		POND_NET	Water in depressions	net	6011	6011
12		POND_DRY_NET	Dry pond	net	6012	6012
13		TANK_NET	Impounded water storage structure	net	6013	6013
14		LAKE_NET	lake	net	6014	6014
15		CREEK_NET	Creek	net	6015	6015
16		BEACH_NET	beach	net	6016	6016
17		LAGOON_NET	lagoon	net	6017	6017
18		SEA_NET	sea	net	6018	6018
19		BARREN_NET	Open area on outskirts	net	6019	6019
20		OPENSPACE_NET	Open land unoccupied/ Vacant land	net	6020	6020
21		ROCKY_NET	Rocky area	net	6021	6021
22		MUDFLT_NET	Mudflat	net	6022	6022
23		MANGROVE_D_NET	Dense Mangrove	net	6023	6023
24		MANGROVE_S_NET	Sparse mangroves	net	6024	6024
25		SALTPN_NET	Salt pans	net	6025	6025
26		QUARY_NET	Stone quarry/ mines	net	6026	6026
27		WATER_TREAT_NET	Water treatment plant	net	6027	6027
28		SEWER_TREAT_NET	Sewarage treatment plant	net	6028	6028
29		RESTRICTED_NET	Restricted / masked area	net	6029	6029

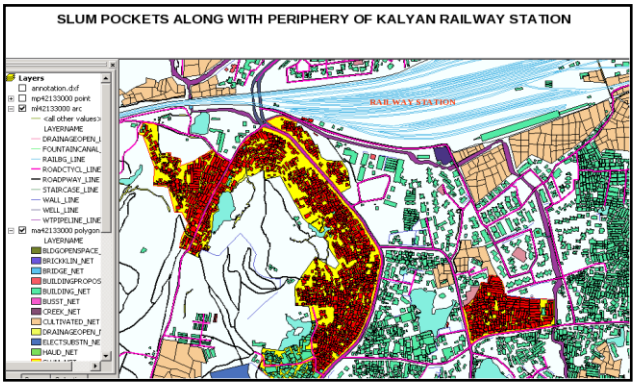
SNo.	Level	LAYER NAME	Description	Type	CODEPAT	CODEAAT
30		SYM_TREE	Tree	Point	6030	6030
G		**RECREATION**				
1		PARK_NET	Park/ garden	net	7001	7001
2		PLAYGND_NET	Play ground	net	7002	7002
3		WTRPRK_NET	Water Park	net	7003	7003
4		SMGPOOL_NET	Swimming Pools	net	7004	7004
5		STDM_NET	Stadium	net	7005	7005
6		SPT_COMPX_NET	Sports Complex	net	7006	7006
7		ZOO_NET	Zoological park & Botanical Gardens	net	7007	7007
8		NAT_PRK_NET	National park	net	7008	7008
9		PLNTRM_NET	Planetarium	net	7009	7009
10		AQUA_NET	Aquarium	net	7010	7010
11		SYM_GYMKHANA	Gymkhana	net	7011	7011
12		SYM_RANGMANDIR	Ranga Mandir	Point	7012	
13		SYM_CINEMA	Movie theater	Point	7013	
14		SYM_HOTEL	Hotel	Point	7014	
15		SYM_CULTCEN	Cultural / Social Centre	Point	7015	
16		SYM_MGLKAR	Marriage , Public utility	Point	7016	
17		SYM_TWNHALL	Town Hall	Point	7017	
18		SYM_RD_ST	Radio Station	Point	7018	
19		sym_TV TOWER	TV STATION			
H		**WORSHIP**				
1		SYM_TEMPLE	Religious	Point	8101	
2		SYM_MOSQUE	Religious	Point	8102	
3		SYM_GURDWARA	Religious	Point	8103	
4		SYM_CHURCH	Religious	Point	8104	
5		SYM_IDGAH	Religious	Point	8105	
6		sym_DARGAH	Religious/ tomb	Point	8106	
7		SYM_BUD_VHR	Budh Vihar	Point	8107	
I		**EDUCATION**				
1		SYM_UNIV	University	Point	9101	
2		SYM_COLLEGE	College	Point	9102	
3		SYM_SCHL_HIGH	High School	Point	9103	
4		SYM_SCHL_MID	Middle School	Point	9104	
5		SYM_SCHL_PRI	Primary School	Point	9105	
6		SYM_LIBRY	Library	Point	9106	
7		SYM_INST	Institutions	Point	9107	
J		**OTHERS**				
1		IMAGE	Raster Satellite Image	Raster	Raster	
2		LEGEND	map legend, Scale, North Arrow, Sheet Index	Template	Template	
3		OFF_LINE	Line drawn to close the polygon	Line		2222
4		MAPOUTER_LINE	Bounding Box which Includes Legend, North Arrow, Scale, & Map	Line		3333
5		CHECK_LINE	Lines not understood and which needs clarification from city survey office.	Line		4444
6		SHEETOUTER_LINE	Line outside the Map boundary			

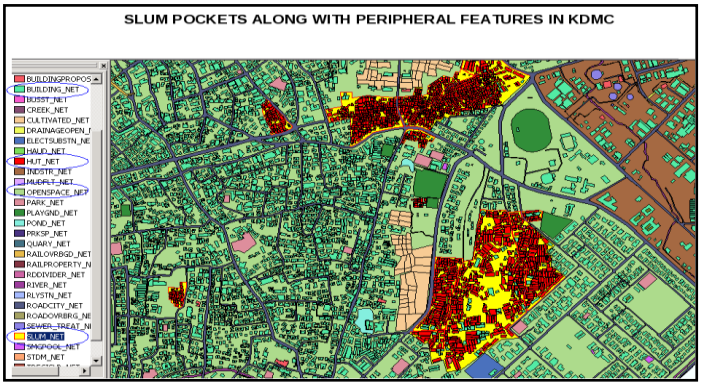
SNo.	Level	LAYER NAME	Description	Type	CODEPAT	CODEAAT
K	**LEVEL**	**TEXT**				
1	1	TEXT_MAPINENGLISH	Text inside the map boundary in English	Annotation		
2	2	TEXT_MAPOUTENGLISH	Name Plate, Text outside the map boundary in English	Annotation		
3	3	TEXT_MAPINMARATHI	Text inside the map boundary in Marathi	Annotation		
4	4	TEXT_MAPOUTMARATHI	Name Plate, Text outside the map boundary in Marathi	Annotation		
5	5	TEXT_REVENUESURVEY_NO	Revenue Survey Number	Poly & Annotation	3	
6	6	TEXT_CITYSURVEY_NO	City Survey Number	Poly & Annotation	4	
7	7	TEXT_RIVISONSURVEY_NO	Rivision survey Number	Poly & Annotation	5	
8	8	TEXT_HISSA_NO	Hissa Number	Poly & Annotation	6	
9	9	TEXT_INAMRIVISION_NO	Inam Rivision Survey Number	Poly & Annotation	7	
10	10	TEXT_PLOT_NO	Plot Numbers	Poly & Annotation	8	
11	11	TEXT_BLDG_NO	Building Number	Poly & Annotation	9	
12	12	TEXT_FLOOR	Floor Number	Annotation		
13	13	TEXT_SURVEY	Survey station details (Theodolite, Plain table, Chain survey point, etc).	Annotation		
14	14	TEXT_TICCOORDINATES	Tic values from the map	Annotation		
15	15	DIMENSION	Dimensions of Road, Rail or Nalla dimensions	Annotation		

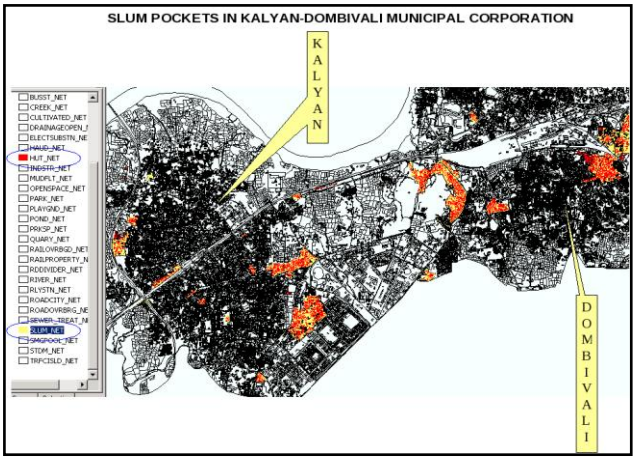
Examples of usage of the above codes:

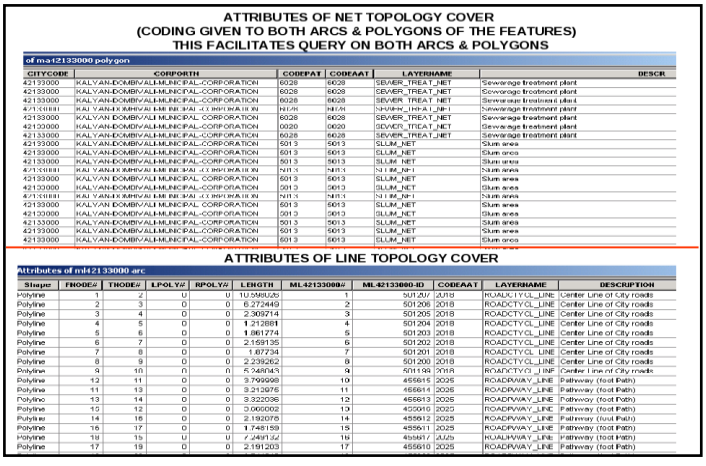












Annexure V

Identification and demarcation of slum areas and vacant land on Base map

There is no universal standard method for all slum identification and mapping. Even within one city, different manifestation of slums may be found, each of which may require specific methodological adjustments for identification and mapping. However, a list of key essential steps is given here:

- Slum free city cells in urban local bodies with the support of the other departments will prepare the list of the existing slums.
- The interpretation key will be adopted to detect informal settlement from satellite images. The following factors will be considered: small sized structures with high density; tone difference to distinguish kaccha or semi-kaccha houses in the slum areas; irregular internal street patterns with un-metalled and mostly unpaved access roads; areas of wastelands – canal/river banks, scatter settlements along railways/road margins.
- For slum resettlements and rehabilitation exercise to be carried out in the later stages of the programme. Vacant lands in the city in close proximity to the existing slums need to be identified. The vacant land may also be identified in the different zones and the peri-urban areas (urban fringe). This could be done in the same procedure as that of the slum identification in the city's satellite image using image analysis parameters that suit the vacant lands.
- Minimum land parcels for slum rehabilitation are to be decided from by planning guidelines issued by the Ministry separately for preparing slum free city plans in the context of RAY.
- After the interpretation of images, the thus identified slum pockets and vacant lands need to be cross checked with that of the available list with the municipality and the land revenue department (as the case may be) and in case of any inconsistencies, field verification is to be conducted (Municipal officer and a NGO/CBO representative will undertake ground truthing exercise).

All the indentified and updated slum pockets and vacant lands will be transferred to one base map to emerge with an overall spatial distribution. All possible parcels for land for

housing settlement would be identified and marked on the base map at different zone levels.

Annexure VI

Metadata

Metadata is a summary document providing content, quality, type, creation, and spatial information about a data set. It can be stored in any format such as a text file, Extensible Markup Language (XML), or database record. Because of its small size compared to the data it describes, metadata is more easily shareable. By creating metadata and sharing it with others, information about existing data becomes readily available to anyone seeking it. Metadata makes data discovery easier and reduces data duplication. ESRI stores metadata with the data set it details and may additionally index metadata in a central database for sharing. For example, ESRI software uses the XML standard for metadata processing.

GIS metadata has a spatial component such as the extent of the earth's surface the data covers. Metadata can describe GIS data, a GIS Web service, or an online metadata catalog. Metadata can also describe nonelectronic data such as paper maps or offline electronic data such as data stored on CD or tape media.

For the Rajiv Awas Yojana (RAY) purposes, it is proposed to include following information while creating Metadata[6].

1. Name of the file
2. Date of creation
3. Data theme/type
4. Content type
5. Source information
6. Name of the layer and type of layer (.shp etc)
7. Accuracy
8. Property code/numbers
9. Software used for data creation
10. Supported data type/information
11. Responsible agency
12. Quality assessment personnel
13. Attribute definition
14. Projection used
15. Spheroid name
16. Datum name
17. Units
18. Zone

[6] (ESRI 2002)

Metadata format for drawing and GIS files

Sr. No.	Field Name	Description
1	Corporation	Name of the Corporation/council
2	Citycode	Census 2001 code
3	Ward	Ward No. of Corporation
4	Docid	Document ID in the form of 'dNNNNN'
5	Source	Source of the document
6	Type	Form of document paper, film, etc.
7	Scale	Scale of map
8	Layers	Number of layers
9	Vendor	Name of consultant creating the document
10	Created	Date of digitization
11	QA by vendor	Q A person of the consultant
12	Q A by corporation	Q A person of corporation
13	Qad	Date of Q A

Annexure VII

Bid and Contract specifications

Where states/cities find it difficult to engage consultants with technical abilities to handle both engineering and GIS areas, separate agencies might be contracted through transparent tendering processes to include tenders for engineering and GIS consultants separately.

1 Illustrative Bid Document[7]

To streamline the process of engaging vendors, consultants and other professional services for the Government of India projects, the Ministry of Finance, GoI, have issued a "Manual of Policies and Procedure of Employment of Consultants". The purpose of these Guidelines is to define the Government of India's broad policies and procedures for selection, contracting and monitoring of consultants and other professional services providers financed from Govt. of India's resources. It is therefore, advised the ULBs, implementing RAY programme adhere to the guidelines listed in the manual.

To help ULBs in selecting a Vendor for creation of a model bidding document is prepared and appended in this section. A few changes are generally necessary to meet local ULBs requirements in the Instructions to Bidders and the Conditions of Contract.

The model Bidding Documents is intended as model Contract. Care should be taken to check the relevance of the provisions of the standard documents against the requirements of the specific Services to be procured. The following directions should be observed when using the documents:

1. All the documents listed in the Table of Contents are normally required for the procurement of Services; however, they should be adapted as necessary to the circumstances of the particular Project.

2. Details to be provided by the ULBs prior to release of the bidding documents are limited to the Invitation for Bids (Section I), Instructions to Bidders and Bidding Data (Section II), and Special Conditions of Contract (Section V), in addition

[7] (YASHADA 2008)

Specifications (and/or Terms of Reference), Drawings, symbology and Activity Schedule, respectively can be included as separate Sections. Specific details should be furnished in the spaces indicated by italicized notes inside brackets. Those details not filled in by the Corporation are the responsibility of the Bidder.

3. Modifications to address specific Project or Contract needs should be provided as amendments to the Conditions of Contract. If modifications are made to the bidding procedures, they can be presented in the Bidding Data.

4. The cover should be modified as required to identify the bidding documents as to the names of the Project, Contract, and Corporation, in addition to the date of issue. In the following paragraphs a model bid document following two bid system for procuring GIS services is described. This document can be appropriately modified and used for procuring GIS services for urban areas.

Illustrative Bid Document
Invitation for Bids
Notes on the Invitation for Bids

The Invitation for Bids is normally issued as

1. An advertisement in at least one newspaper of national circulation in the country and in two news papers of state and local circulation and in the official gazette, if any; and

2. A letter addressed to a Service Providers who, had expressed interest in bidding for the Services required.

Its purpose is to supply information to enable potential bidders to decide on their participation. Apart from the essential items listed in these Sample Bidding Documents, the Invitation for Bids should also indicate any important bid evaluation criteria.

The Invitation for Bids may be incorporated in the bidding documents merely for the record, or it may be omitted. In either event, the information contained in the Invitation for Bids should conform to the bidding document, and in particular, to the relevant information in the Bidding Data and the Special Conditions of Contract.

Invitation for Bids (IFB)

The Municipal Corporation of ….., invites sealed bids in prescribed form in two envelops system, one for technical and the other for commercial proposal , from eligible Bidders for carrying out the Creation of large scale database in GIS environment using high resolution satellite images , large scale maps and field Survey data , wherein the work involves scanning, digitization, geo-referencing, edge matching, mosaicing and information extraction pertaining to the infrastructure, utilities / facility /amenity, urban land use, surveying and conversion of vector data format etc.

Bidding documents (and additional copies) may be purchased at *[name and address of Municipal Corporation office]* for a nonrefundable fee of *[amount in Rupees]*, for each set. Interested bidders may obtain further information at the same address.

Bids shall be valid for a period of *[days]* after Bid opening and must be accompanied by bid security of *[amount in Rupees]* or its equivalent in a convertible currency, and shall be delivered to *[name and full address of receiving office]* on or before *[time and date of Bid closing]*, at which time they will be opened in the presence of the bidders who wish to attend. Late bids will be rejected.

Bids of those qualifying in the Technical Qualification described in Section – I will be considered for evaluation, while that of disqualified bidders will be returned unopened.

The attention of prospective Bidders is drawn to the fact that they will be required to certify in their bids that all software used is either covered by a valid license or was produced by The Bidder.

Place: ***Commissioner/ Admin Officer***
Date: ***Municipal Corporation of ….***

1.2 Illustrative Technical Qualification Proposal

Instructions to Bidders on Technical Qualification Proposal

The proposal would be evaluated by the evaluation Committee constituted by the Municipal Corporation on the basis of criteria set out in the technical qualification document to identify the successful bidders for execution of the work.

1.2.1 Scope of Work

The scope of services include provision of GIS support services to create geo-referenced city base map showing slums using high resolution satellite images, to overlay all infrastructure data like Road, Property, Drain, Sewer, Water supply, Utility points erected on the road/footpaths, culverts, Street lights, Bus shelters, hoardings, Traffic points data etc. over the base maps, in various layers. These maps are to be created using the physical surveying (Total Survey Station or GPS technology), ancillary data, departmental input and collection of data for attributes of various layers. The maps thus created should be geo-referenced and Geographic Information Systems compatible. The field data collection, validation with municipal and other records and integrating with the base maps are also to be provided by the Bidders.

The scope of works shall include the following major components. (*The corporations can add more work here and or delete a few if not required by them*)

a. Preparing the Base Map in GIS environment using satellite images and geo-referencing of city survey maps at various specified scales (1:2000 or 1:5,000, 1:10000) and 1:50,000 SOI based referencing for broader coverage of the entire city/ township.

b. Field verification and creation of city base maps and property maps For slum areas.

c. Mapping of slums and collection of data regarding slums.

d. Mapping of various Utilities like water, electric, sewage, street lighting etc, using spatial survey (like Total Station Survey), GPS and Ground penetrating Radar (GPR) where ever necessary.

e. Conducting field surveying for slum areas to generate contours of 0.5 meter interval for creation of Digital Terrain maps for drainage planning / disaster management etc.

1.2.2 Type of Illustrative contract

The entire work may be distributed to multiple consultants in order to meet the project schedule as and when required. The job contract would be awarded to the empanelled consultants in lots/sections. The job contract of one section at a time would be awarded. Next section would be awarded after successful completion of the previous awarded work.

All activities will have to be executed at Corporation office premises. If required, Consultants will have to carry out physical site verification as well as collect the additional data for spatial features. The proposal shall remain valid for a period of two years from the date of issue of notification of award unless extended by mutual consent subject to satisfactory performance of the work by consultants. Corporation reserves the right to accept or reject any or all the proposals /bids which does not meet the requirement without assigning any reason thereof. The consultant should clarify that their firm is not black listed or debarred for participating in any bid/ tender by the State /any Govt. agency.

1.2.3 Content of Qualification and Bidding Documents

The contents of the Technical Qualification and Bid Documents are listed below and should be read in conjunction with any addenda issued:

Section I Technical Qualification Proposal
Section II Sample forms for Technical Qualification
Section III Bidding Document
Section IV Sample Forms for Commercial Bidding

Bidders are expected to examine all instructions, forms, terms, specifications, and other information in the Qualification and Bid Document. Failure to furnish all information required by the Document or to submit a bid not substantially responsive to the Qualification and Bid Document in every respect will be at the Bidder's risk and may result in its rejection.

1.2.4 Bid Opening

The following is the schedule of bid opening:

The date of opening of technical qualification proposal is (*insert Date*) at (*insert time*) Hrs.

The expected date of opening of commercial bid will be indicated to the technically qualified bidders by the telephone/ fax/ mail.

1.2.5 Technical Qualification Criteria

1.2.5.1. Experience

a. Qualification will be based on Bidders meeting all the following minimum criteria regarding their general and particular experience, financial position, personnel and equipment capabilities, other relevant information as demonstrated by The Bidder's responses in the Information Forms attached to the Letter of Application and evaluation of the sample work.

b. The Bidder shall provide evidence that it has been engaged in Remote Sensing / GIS activities/ mapping utilities/large scale database creation, in the role of prime Consultant, partner in a joint venture, or sub consultant.

c. The Bidder should also give evidence that it has successfully completed or substantially completed work of a nature, complexity, and requiring technology similar to the proposed contract. The works may have been executed by The Bidder as a prime Consultant, or proportionately as member of a joint venture, or sub Consultant, with references being submitted to confirm satisfactory performance.

d. The Bidder have to compulsorily produce the documentary evidence for completion of the work of similar nature valued with turnover of not less than Rs. …… lakhs (in words) for each of the last three financial years

1.2.5.2. Financial Capabilities

a. The Bidder shall demonstrate that it has access to, or has available, liquid assets, unencumbered real assets, lines of credit, and other financial means (independent of any contractual advance payment) sufficient to meet the activity cash flow requirements for the subject contract(s) in the event of stoppage, start-up, or other delays in payment, of the
b. The minimum estimated amount of Rs *(specify amount in Rs)* or in multiples thereof depending on the number of lots taken up simultaneously.

c. In the relevant Information Form, The Bidder shall also demonstrate, to the satisfaction of Corporation, that it has adequate sources of finance to meet the

cash flow requirements on activities currently in progress and for future contract commitments.

d. The audited balance sheets or, other financial statements acceptable to Corporation, shall be submitted and must demonstrate the soundness of The Bidder's financial position. If deemed necessary, Corporation shall have the authority to make inquiries with The Bidder 's bankers.

1.2.5.3 Personnel Capabilities

The Bidder shall provide general information on the management structure of the firm, and shall identify the suitably qualified personnel of the proposed project team including Project Manager, GIS Specialist and Image processing /CAD specialist as required during contract implementation. The Bidder shall provide further details of the proposed personnel and their experience records in the relevant Information Forms 6 and 6A.

1.2.5.4 System Capabilities

The Bidder shall own, or have assured access (through hire, lease, purchase agreement, or other commercial means, or approved subcontracting) to systems including licensed software, in full working condition, as listed below, and must demonstrate that, based on known commitments, they will be available for timely use in the proposed contract.

1.2.5.5 System Types

1. GIS Systems
2. CAD Systems and
3. Image Processing Systems etc.
4. GPS systems and post processing softwares
5. Total station survey equipment and data conversion capabilities

1.2.5.6 Methodology & Project Plan

The Bidder must attach with their application, a detail note giving a general description on the approach to the methods, specifications, data formats, technologies, quality assurance schemes proposed, deployment schedule, capacity, number of systems proposed to be used, number of lots that it can undertake simultaneously,

etc., for ensuring completion of the work as per specifications within the desired time-frame.

1.2.5.7 Submission of Sample work

The Bidder should submit the completed sample work in digital format on CD-ROM along with the Qualification Document. The deliverables of the sample work will be:

- Vectorised city cadastral maps in paper coordinates with all the features captured in various layers with unique ids. The deliverables to be submitted in drawing export format (DXF)/ coverage / geodatabase.
- Vectorised individual city cadastral map Raw coverage (point line and poly coverage with line and polygon topology), with all features and unique ids in GIS data format.
- Geo-referenced individual city cadastral maps, coverage (point, line and poly coverage with line and polygon topology) with all features and unique ids in GIS format (specify specific format of the same for necessary conversion, if needed)
- Mosaic of individual city cadastral maps, Geo-referenced vector map with all features captured with unique IDs in GIS format (or specifies your required data format).
- Layer-wise feature extraction from satellite image with proper annotation, symbology and unique ID to facilitate attribute attachment
- Metadata file in excel format (Ref **Annexure VI** for summarized format). ULBs may also refer to the NSDI format covering 28 elements in detail: http://nsdiindia.gov.in/nsdi/nsdiportal/images/NSDIMetadataDocument.pdf
- Surveying of utilities like water pipelines, sewage lines, electric lines etc using ground penetrating Radar (GPR) where ever applicable and associated attribute data collection.
- Surveying of slums and collection of individual house hold data.
- Property tax mapping and collection of property tax house hold data.
- A write up on the methodology followed, accuracy parameters including error limitations and systems used.

1.2.5.8 Litigation History

The Bidder shall provide accurate information on the related Application Form about any litigation or arbitration resulting from contracts completed or ongoing under its execution over the last two years. A consistent history of awards against The Bidder or any partner of a joint venture may result in failure of the application.

1.2.5.9 Right to Waive

Corporation reserves the right to waive minor deviations in the qualification criteria if they do not materially affect the capability of the Bidder to perform the contract.

1.2.5.10. Disqualification

Even though The Bidder meets the qualification criteria, they are subject to be disqualified if they have:

- made misleading or false representation in the form, statements and attachments submitted; and/or

- Record of poor performance such as abandoning the work, not properly completing the contract, inordinate delays in completion, litigation history, or financial failures, etc.

Illustrative form for Technical Qualification

Technical Qualification Proposal

[letterhead paper of The Bidder or partner responsible for a joint venture, including full postal address, and telephone, facsimile and telex numbers, and cable address]
Date:
To:

Project Name: Creation of large scale slum survey and creating geodatabase of the slums.
1. Being duly authorized to represent and act on behalf of _____ (hereinafter referred to as "The Bidder "), and having reviewed and fully understood all of the Qualification requirements and information provided, the undersigned hereby applies for Qualification to bid on the contract or contracts indicated below:
Contract No: Corporation /……., Dated .

2. Attached to this letter are copies of original documents defining1:

(a) The Bidder 's legal status;

(b) the principal place of business; and

(c) the place of incorporation (for Bidders that are Corporations), or the place of registration. (for Bidders that are partnerships or individually owned firms).

3. Corporation and its authorized representatives are hereby authorized to conduct any inquiries or investigations to verify the statements, documents, and information submitted in connection with this application, and to seek clarification from our bankers and clients regarding any financial and technical aspects. This Letter of Application will also serve as authorization to any individual or authorized representative of any institution referred to in the supporting information to provide such information deemed necessary and as requested by yourselves to verify statements and information provided in this application, such as the resources, experience, and competence of The Bidder.

4. Corporation may contact the following persons for further information:

General and managerial inquiries	
Contact 1	Address and communication facilities
Contact 2	Address and communication facilities

Personnel inquiries	
Contact 1	Address and communication facilities
Contact 2	Address and communication facilities

Technical inquiries	
Contact 1	Address and communication facilities
Contact 2	Address and communication facilities

Financial inquiries	
Contact 1	Address and communication facilities
Contact 2	Address and communication facilities

5. This application is made with the full understanding that:

(a) bids by qualified Bidders will be subject to verification of all information submitted for Qualification and bidding;

(b) Corporation reserves the right to:

amend the scope and value of any contracts to be bid under this project; in which event, bids will be invited only from those Bidders who meet the resulting amended Qualification requirements; and

reject or accept any application, cancel the Qualification process,
and reject all applications.

(c) Corporation shall not be liable for any such actions under 5(b) above.

6. Appended to this application, we give details of the participation of each party, including capital contribution and profit/loss agreements, in the joint venture or association. We also specify the financial commitment in terms of the percentage of the value of the contract, and the responsibilities for execution of the contract.

7. We confirm that any resulting contract, will be:

(a) signed so as to legally bind all partners, jointly and severally; and

(b) submitted with a joint venture agreement providing the joint and several liability of all partners in the event the contract is awarded to us.

8. The undersigned declare that the statements made and the information provided in the duly completed application are complete, true, and correct in every detail.

Signed Name	Signed Name
For and on behalf of (name of Bidder / Consultants or partner in charge of a joint venture)	For and on behalf of (name of Bidder / Consultants or partner in charge of a joint venture)

(Sections 2.5 through 2.7 are borrowed from Manual on Geographic Information Systems for Urban Areas, YASHADA, Pune)

1.8. Expertise and Inputs

The staff proposed should have experience in the design of services; experience in managing and developing client relationship; in product development, project management; and also experience in technologies like Windows operating systems; client/server hardware and software; input/output technology, digitizing equipment, internet services and related technologies.

Annexure VIII

Illustration of data integration from MIS to GIS

The illustration given hereunder is the procedure adopted using the ArcGIS software. Data from a tabular relational database can be brought into ArcGIS(and most other GIS software programs) in at least two ways:

- Databases in .dbf format can be imported into ArcGIS from any source that supports the .dbf format
- Databases can be queried "live" using SQL and ODBC capabilities - this method may be preferable in situations where data is continually being updated by MIS System (Surveys).

Using the Open Database Connectivity (ODBC) Manager to Configure a Connection:

The ODBC Manager in Windows XP/NT manages how different databases including Excel, Access, Arcview, etc., can link to one another. Before any link is made a connection must be established by using the ODBC Manager. Following steps illustrates the procedure.

1. Click on the Windows START button, then go to SETTINGS - CONTROL PANEL
2. In the CONTROL PANEL window, double click on the ODBC icon.
3. Following interface form will be visible.

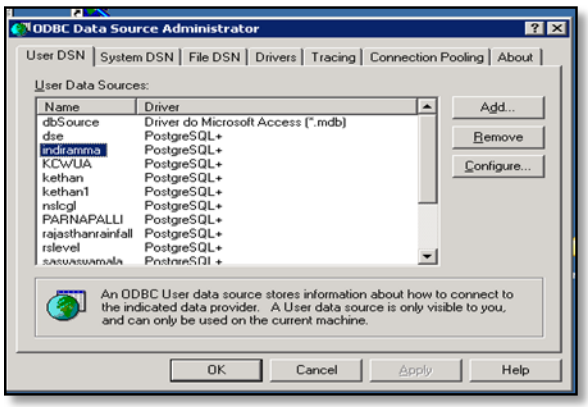


Figure 13: ODBC data source admin

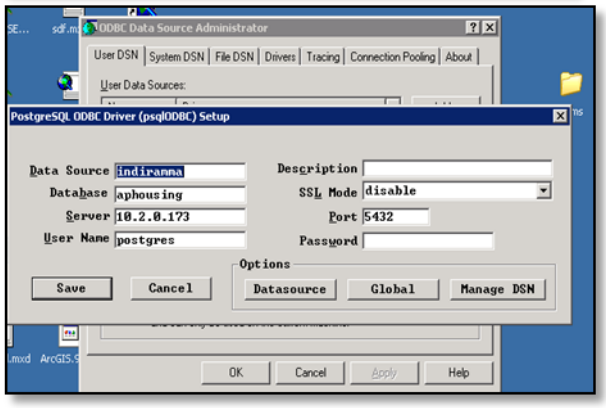
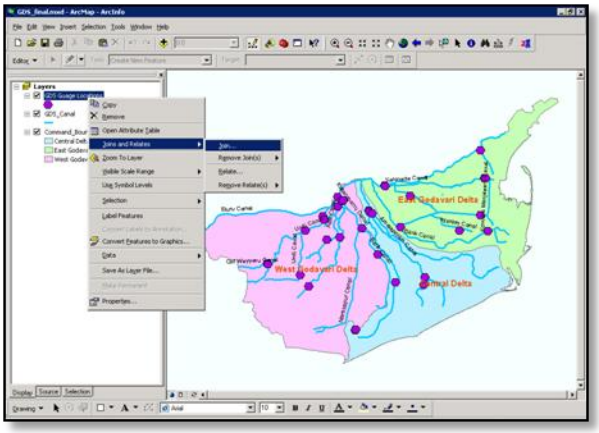


Figure 14: ODBC data source set up

4. Under the User DSN tab, click Add.
5. Select the Microsoft Access Driver and click Finish.
6. For Data Source Name, type ms-access
7. Choose OK. The "ms-access" driver should now appear under User Data Sources
8. Click OK to exit
9. Close the CONTROL PANEL
10. The Basic SQL Connect Process
11. Assuming there is access to Postgre database (including tables or queries), follow these steps to connect to it from ArcGIS. By right clicking the appropriate layer, system will display the popup menu.



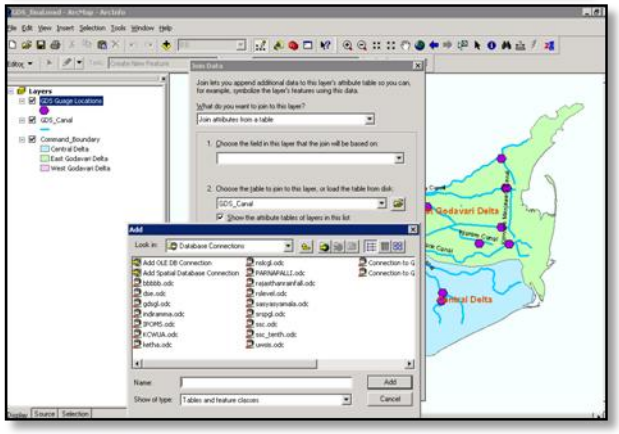
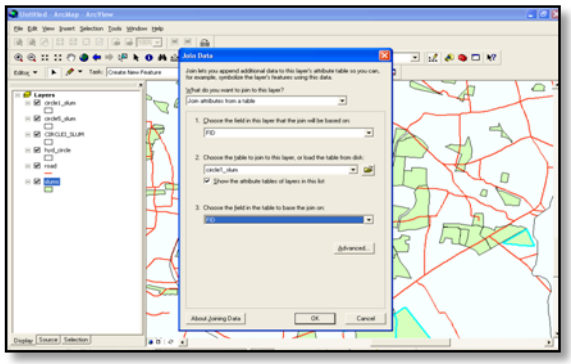


Figure 15: Linking data source to ArcGIS basemap Figure 16: Linking MIS table to ArcGIS base map

12. As shown in Figure 15, go to 'Join and Relates' and then click on 'join'. The system will display the below screen.
13. Referencing Figure 16 above, browse the relevant data source and select the app table and chose the common field in the ArcMap attribute data and the data source table. With this process the system will link the data to ArcMap.



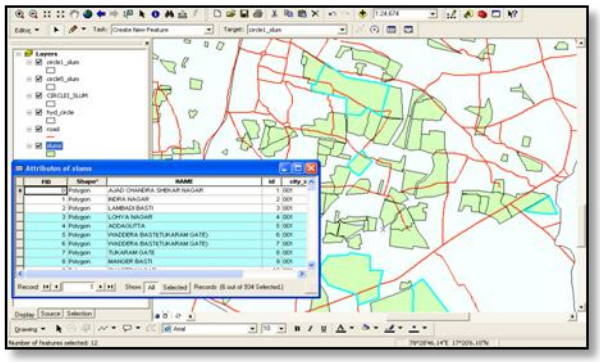


Figure 17: Linking the MIS fields to ArcIMS basemap Figure 18: ArcIMS, MIS data mapped

After joining the data source to ArcIMS, MIS data mapped will be displayed as shown in Figure 17 & 18.

Annexure IX

List of empanelled agencies for quality assurance of base maps/GIS maps

S.No	Organisation
1.	National Remote Sensing Centre (NRSC/ISRO), Hyderabad and its Regional Centres located at Dehradun, Kharagpur, Nagpur, Jodhpur and Bangalore
2.	APSRAC, Hyderabad
3.	BISAG, Ahmedabad
4.	MRSAC, Nagpur
5.	Survey of India / Indian Institute of Surveying and Mapping, Hyderabad
6.	Indian Institute of Remote Sensing, Dehradun
7.	Centre for Good Governance (CGG), Hyderabad
8.	North Eastern Space Application Centre, Shillong
9.	State Remote Sensing Application Centres of various states(for contact address refer Annexure XII

Annexure X

Community participation in slum mapping

The main purpose is to bring community participation or representative NGOs involvement in all the required stages and to integrate their inputs in to GIS mapping.

Steps:

- Preparation of base map using satellite imageries, SOI toposheets, planning maps from different sources.
- Involve NGOs in demarcation of important features on a 1:2000/ 1: 5000 scale.
- Preparation of slum level map on 1:500 scale using cadastral map, Total Station & other large scale spatial mapping techniques.
- Experts and local community will work together until a reasonable competency level is achieved. After that individual and group assessments will be made by the local community themselves.
- Workshop will be arranged to enable agreement on existing slum and existing infrastructure, vulnerability of the area, identification of vacant land and how local people will map them according to their perception and to fit it into GIS domain.
- The local people will identify disputed land and the slum boundaries will be cross checked with local people's inputs.
- Monitoring and evaluation is included in the process to come up with GIS map with effective merging of community participation and sophisticated GIS techniques.

Land ownership/ land tenure mapping

The most important task is to mapping the land ownership titles / land tenure status for parcel of land within the demarcated slum area and vacant land.

The information will be collected from land revenue/ municipal records for entire slum pockets and vacant land and all the plot boundaries showing the ownership/ tenure status will be georeferenced.

The unclear and disputed land should be marked over the map. This will help to initiate the dispute resolution process to clear the land tenure status.

The relevant tenure information will be recorded in a database and, once the whole process is completed, each parcel is given an identification number. This ID is entered into both the GIS map database and the database, so that textual information can be linked to the parcels on maps. Such maps can be presented to the community at public displays, where even untrained map-readers can find their parcel and confirm the accuracy of the information.

Annexure XI

List of Standard GIS Package including Open Source product

1. **ESRI:** – Products include ArcView 3.x, ArcGIS, ArcSDE, ArcIMS, ArcWeb services and ArcGIS Server. The GIS tools are available, module wise and hence while procurement, the required module could be selected as per requirement. For most of the operations basic module will be sufficient.
2. **IGiS:** An Indigenous GIS software tool which is designed by ISRO/ DOS (An Integrated GIS and Image Processing Software). This is a versatile Geomatics software which includes GIS, image processing and its integration with real time information using GPS. The tool very useful for most of the basic operations of data processing both for rasters and vectors and could serve the project efficiently for database creation. Technology transfer is done to M/s ScanPoint Pvt. Ltd. for training and marketing of the package.
3. **Intergraph**: Products include GeoMedia, GeoMedia Professional, GeoMedia WebMap, and add-on products for industry sectors, as well as photogrammetry.
4. **MapInfo:** by Pitney Bowes – Products include MapInfo Professional and MapXtreme.
5. **Bentley Systems**: Products include Bentley Map, Bentley PowerMap and other products that interface with its flagship MicroStation software package.
6. **ERDAS IMAGINE:** by ERDAS Inc; products include Leica Photogrammetry Suite, ERDAS ER Mapper, and ERDAS ECW JPEG2000 SDK (ECW (file format))are used throughout the entire mapping community (GIS, Remote Sensing, Photogrammetry, and image compression).
7. **GRASS GIS:** Originally developed by the U.S. Army Corps of Engineers, open source: a complete GIS
8. **ILWIS:** ILWIS (Integrated Land and Water Information System) integrates image, vector and thematic data.
9. **IDRISI:** GIS and Image Processing product developed by Clark Labs at Clark University.
10. **TerraView:** GIS desktop that handles vector and raster data stored in a relational or geo-relational database
11. **DIVA-GIS:** DIVA-GIS is a free computer program for mapping and geographic data analysis (a geographic information system)
12. **Autodesk Products:** Autocad, Map 3D, Raster Design and Map Guide & Topobase.

Annexure XII

Detailed Contact Addresses of State Remote Sensing Centres

S.NO	ADDRESS
1	DR K.MRUTHYUNJAYA REDDY DIRECTOR GENERAL AP STATE REMOTE SENSING APPLICATIONS CENTRE OFFICE OF DES CAMPUS 2ND FLOOR, OPP. MCH CIRCLE OFFICE, KHAIRATABAD HYDERABAD PIN CODE: 500 004. ANDHRA PRADESH PHONE: 040 23300883 FAX: 040 23311553 EMAIL: kmruthyu@yahoo.com
2	SHRI S. DE. SARKAR DIRECTOR cum MEMBER-SECRETARY STATE REMOTE SENSING APPLICATION CENTRE ARUNACHAL PRADESH STATE COUNCIL FOR SCIENCE & TECHNOLOGY VIVEKNAGAR ITANAGAR PIN CODE: 791 113 ARUNACHAL PRADESH PHONE: 0360 2290833, 09436044043 FAX: 0360-2212934
3	DR.S.K.CHOUDHURY DIRECTOR ASSAM REMOTE SENSING APPLICATION CENTRE (ARSAC) ASTE COUNCIL, BIGYAN BHAVAN , NEAR IDBI BUILDING, G.S.ROAD GUWAHATHI - 781 005 ASSAM PHONE: 0361-2464619, 621 FAX: 0361 2464617
4	DR. ASHOK KUMAR THE PROJECT DIRECTOR BIHAR REMOTE SENSING APPLICATION CENTRE (BIRSAC) PLANETARIUM COMPLEX, ADALATGANJ, PATNA PIN CODE: 800 001 BIHAR STATE PHONE: 0612 2226497,2235264 FAX: 0612 2226497,2230432 EMAIL: deepa0618@yahoo.com
5.	DR. M.S. NATHAWAT PROFESSOR & HEAD

	BIRLA INSTITUTE OF TECHNOLOGY DEPT OF REMOTE SENSING & GEOINFORMATICS MESRA, RANCHI – 835 215 PHONE: 0651 2275444 / 2275896 FAX: 0651 2276003 EMAIL: msnathawat@bitmesra.ac.in, msnathawat@yahoo.com
6.	PROF. ANJANA VYAS DEAN, FACULTY OF GEOMATICS & SPACE APPLICATIONS CEPT UNIVERSITY KASTURBHAI LALBHAI CAMPUS, UNIVERSITY ROAD, NAVARANGPURA AHMEDABAD – 380 009 PHONE: 079 2630 2470 FAX: 079 2630 2075 EMAIL: anjanavyas@yahoo.com
7	DR N.P. S. VARADE DIRECTOR GOA STATE REMOTE SENSING CENTRE (GSRSC) DEPT. OF SCIENCE, TECHNOLOGY & ENVIRONMENT OPP. SALIGAO SEMINARY, SALIGAO BARDEZ GOA PIN CODE: 403 511 PHONE:0832 2407580 FAX: 0832 2407186 EMAIL: ste@goa.goa.nic.in
8	DR T.P SINGH DIRECTOR BHASKARACHARYA INSTITUTE FOR SPACE APPLICATIONS AND GEO-INFORMATICS (FORMERLY REMOTE SENSING AND COMMUNICATION CENTRE (RESEC) INDULAL YAGNIK MARG, NEAR CH '0' CIRCLE GANDHINAGAR-AHMEDABAD HIGHWAY GANDHINAGAR PIN CODE: 382 007 GUJARAT PHONE: 079 2321 3081, 2321 3082, 2321 3090 FAX: 079 2321 3091 EMAIL: info@bisag.gujarat.gov.in
9	DR RAMESH S HOODA CHIEF SCIENTIST HARYANA SPACE APPLICATIONS CENTRE (HARSAC) ESTATE OFFICE BUILDING, CCS HAU CAMPUS HISSAR PIN CODE: 125 004 HARYANA PHONE: 01662 232632 / 225958 FAX: 01662 225958 EMAIL:hoodars@yahoo.com
10	THE HEAD HP STATE REMOTE SENSING CENTRE

	REVENSDALE ESTATE SHIMLA PIN CODE: 171 002 HIMACHAL PRADESH PHONE: 0177 2622490 FAX: 0177 2620998 EMAIL: ssrandhawa15@gmail.com
11	THE DIRECTOR, DIRECTORATE OF ECOLOGY, ENVIRONMENT & REMOTE SENSING WINTER MONTHS PARIYAVARAN BHAVAN TRANSPORT NAGAR, GLADNI NARWAL JAMMU FAX: 0191 2472742 EMAIL: jksrsc@yahoo.co.in SUMMER MONTHS SDA HOUSING COLONY, BEMINA SRINAGAR – 190 018 JAMMU & KASHMIR PHONE: 0194 2490823
12	DR.A.T.JEYASEELAN DIRECTOR JHARKHAND SPACE APPLICATION CENTRE GOUND FLOOR, ENGINEERING HOSTEL-2 NEAR GOL CHAKKAR, DHURWA RANCHI PIN CODE: 834004 JHARKHAND STATE PHONE:0651 2401719 FAX:0651 2401720 EMAIL: jey_directorjsac@jharkhand.gov.in
13	DR. D.K. PRABHURAJ DIRECTOR KARNATAKA STATE REMOTE SENSING APPLICATION CENTRE (KSRSAC) DEPT. OF IT & BIOTECHNOLOGY NO.611, 4TH STAGE, 6TH FLOOR, MS BUILDING DR AMBEDKAR VEEDHI BANGALORE PIN CODE: 560 001 KARNATAKA PHONE:080 22371321, 22371325 FAX:080 22371322 EMAIL: ksrsac_gok@yahoo.co.in
14	MR. RAJENDRA P. SHARMA, IFS DIRECTOR KERALA STATE REMOTE SENSING AND ENVIRONMENT CENTRE VIKAS BHAVAN THIRUVANANTHAPURAM PIN CODE: 695 033 KERALA PHONE: 0471 2307830, 2302231

	FAX:0471 2300624 EMAIL: ksrecnet@vsnl.com
15	PROF. PRAMOD K. VERMA, DIRECTOR GENERAL & SCIENTIFIC ADVISOR MP COUNCIL OF SCIENCE & TECHNOLOGY VIGYAN BHAVAN NEHRU NAGAR BHOPAL PIN CODE: 462 003 MADHYA PRADESH PHONE: 0755 2671800 FAX: 0755 2671600 EMAIL: dg@mpcost.nic.in
16	DR.VINOD M BOTHALE DIRECTOR MAHARASHTRA REMOTE SENSING APPLICATION CENTRE (MRSAC) VISVESWARAYA REGIONAL COLLEGE OF ENGG. CAMPUS SOUTH AMBAZARI ROAD NAGPUR - 440 011 MAHARASHTRA PHONE: 0712 2220032 FAX: 0712 2225893 EMAIL: mrsac_ngp@sancharnet.in , vinod.bothale@gmail.com
17	SHRI N SHAMUNGOU SINGH DIRECTOR MANIPUR REMOTE SENSING APPLICATION CENTRE NEW SECRETARIAT BUILDING, ROOM NO. 101 IMPHAL PIN CODE: 795 001 MANIPUR PHONE: 098622700336 FAX: 0385 2451816 EMAIL: mrsac@yahoo.co.in
18	DR. S. SUDHAKAR DIRECTOR NORTH EASTERN SPACE APPLICATIONS CENTRE (NE-SAC) DEPT. OF SPACE, GOVT. OF INDIA UMIAM SHILLONG – 793 103 (MEGHALAYA) PHONE: 0364 2570140, 2570012, 2570141 FAX: 0364 2570139
19	DR. RK LALLIANATHANGA SR. SCIENTIFIC OFFICER & PROJECT DIRECTOR MIZORAM STATE REMOTE SENSING APPLICATION CENTRE SCIENCE, TECH. & ENVN. CELL, PLANNING DEPT., GOVERNMENT OF MIZORAM AIZWAL PIN CODE: 796 012 MIZORAM PHONE: 09436140957 FAX:

	EMAIL:
20	DR. ZAVEI HIESE MEMBER-SECRETARY NAGALAND SCIENCE AND TECHNOLOGY COUNCIL OLD SECRETARIAT COMPLEX KOHIMA – 797 001 (NAGALAND) PHONE: 0389 2271007 FAX: 0389 2346139, 2322414 EMAIL: msrsc@sancharnet.in
21	SHRI A.K. MOHAPATRA, IFS THE CHIEF EXECUTIVE ORISSA REMOTE SENSING APPLICATION CENTRE (ORSAC) PLOT NO.45/48 (PART), JAYADEV VIHAR NEAR GOPABANDHU ACADEMY OF ADMINISTRATION, UNIT 16 BHUBANESWAR PIN CODE: 751 023 ODISHA STATE PHONE: 0674 2303625,3293545 FAX: 0674 2300681 EMAIL: orsac@gramsat.nic.in
22	DR PK SHARMA DIRECTOR PUNJAB REMOTE SENSING CENTRE (PRSC) PUNJAB AGRICULTURAL UNIVERSITY CAMPUS LUDHIANA PIN CODE: 141 004 PUNJAB PHONE: 0161 2303484 FAX: 0161 2303483 EMAIL: prscoffice@rediffmail.com
23	SHRI SREEDHARAN M DIRECTOR STATE REMOTE SENSING APPLICATION CENTRE GOVT. OF PONDICHERRY 505, KAMARAJ SALAI, SARAM PONDICHERRY PIN CODE: 605 103 PHONE: FAX: EMAIL:
24	DR N.K. KALRA PROJECT DIRECTOR STATE REMOTE SENSING APPLICATION CENTRE (SRSAC) GOVERNMENT OF RAJASTHAN DEPT. OF SCIENCE & TECHNOLOGY SUBHASHNAGAR, PAL ROAD JODHPUR PIN CODE: 342 008 RAJASTHAN PHONE: 0291 2785105

	FAX: 0291 2785531 EMAIL: kalra_nk_dr@yahoo.co.in, srsacju@yahoo.co.in
25	SHRI ML ARRAWATIA, IFS DIRECTOR (S&T) SIKKIM STATE REMOTE SENSING APPLICATION CENTRE GOVERNMENT OF SIKKIM FOREST SECRETARIAT, GANGTOK PIN CODE: 737 102 SIKKIM PHONE: 03592 205551,281778 FAX: EMAIL:
26	SHRI N. DATTA HEAD TRIPURA STATE COUNCIL FOR SCIENCE & TECHNOLOGY PANDIT NEHRU COMPLEX, GORKHABASTI PO: KUNJABAN AGARTALA – 799 006 (TRIPURA) PHONE: 0381 2301365 FAX: 0381 2301365 EMAIL: stcouncil@sancharnet.in
27	DR.M.RAMALINGAM DIRECTOR INSTITUTE OF REMOTE SENSING (IRS) COLLEGE OF ENGINEERING ANNA UNIVERSITY, GUINDY CHENNAI PIN CODE: 600 025 TAMILNADU PHONE: 044 22358151/22358152 FAX: 044 22352166 EMAIL:dirirs@annauniv.edu
28	THE DIRECTOR REMOTE SENSING APPLICATION CENTRE (RSAC-UP) SECTOR-G, JANKIPURAM, KURSI ROAD LUCKNOW PIN CODE: 226 007 UTTAR PRADESH PHONE: 0522 2730825 FAX: 0522 2730535 EMAIL: rsacup@yahoo.com
29	DR.M.M. KIMOTHI DIRECTOR UTTARKHAND SPACE APPLICATION CENTRE 7, NEW CANTT ROAD DEHRADUN UTTARANCHAL PHONE: 0135 2763393 FAX: 094107 27461 EMAIL:

30	PROF. SARADINDU SENGUPTA ADVISOR WEST BENGAL STATE COUNCIL OF SCIENCE & TECHNOLOGY BIKASH BHAVAN, NORTH BLOCK (4TH FLOOR) SALT LAKE KOLKATA – 709 091 PHONE: 033 23342969, 23344616, 23211342 FAX: 033 23344616
31	THE DIRECTOR CHHATTISGARH SPACE APPLICATION CENTRE CHHATTISGARH COUNCIL OF SCIENCE AND TECHNOLOGY LOKESH PLAZA,FIRST FLOOR SHANKAR NAGAR RAIPUR- 492007 CHHATTISGARH STATE Fax: 0771-2263757 Email: p_k_bhat@sify.com

Annexure XIII

Bhuvan: Web Geoportal for Indian Earth Observation data

Vision

To evince the distinctiveness of Indian imaging Capabilities through online rendering of multi–resolution, multi-temporal and multi-sensor Indian Remote sensing Satellite (IRS) data with value added Services on 3D globe for public good.

Introduction

Bhuvan is an initiative to showcase Indian imaging Capabilities with a focus on Indian region, including Global coverage. It is an ambitious project of ISRO to take Indian images to other value added services in multiple spatial resolutions to the people through a web geoportal for easy access to information on basic natural resources in the geospatial domain. Bhuvan showcases IRS images in 2D and 3D perspectives with excellent rendering capabilities. It displays satellite images of varying resolutions with respect to earth surface, allowing users to visualize features like cities and important places of interest in different perspectives and navigation possibilities over India.

The degree of resolution showcased is based on the points of interest and popularity and the entire Indian terrain is covered upto 6 meter spatial resolution for display. With such a content and rich rendering possibilities, the door to net centric visualization of digital geospatial data with a unique experience of interactive terrain viewing and maneuverability options have been successfully enabled.

Multi-resolution images from IRS satellites are seamlessly organised to depict Natural features on Web geoportal to enable common-man to zoom into specific area of interest at varying resolutions with even vector overlay capability. Bhuvan brings a whole lot of uniqueness in understanding our own natural resources whilst presenting beautiful images and thematic information generated from varieties of geospatial data. Bhuvan also attempts to bring out the importance of multi-temporal data that could help in detecting changes that take place to our natural resources.

Bhuvan is an interactive versatile visualization system that allows user to navigate (or “fly”) across the entire globe, view satellite imageries with overlays of administrative boundaries, transport network, geographic features, and numerous other location-specific data points. Users can add their own points of interest and share them with others, chart routes, plot areas, calculate distances, and overlay vectors by choice onto the application. Bhuvan provides online information on land and ocean resources in addition to disaster and others. The ocean information is more specific on potential fishing zones (PFz) powered through the INCOIS services of Ministry of Earth Sciences..

Users can show or hide available layers in any combination. Using the scale and the robust measurement and terrain analysis tools, one could plot mileages, calculate elevation difference and slope angle

between two or more points in the 3D view, terrain elevation profile along a path, find places of interest along the way, and link to Web sites to contact those establishments.

How to use Bhuvan?

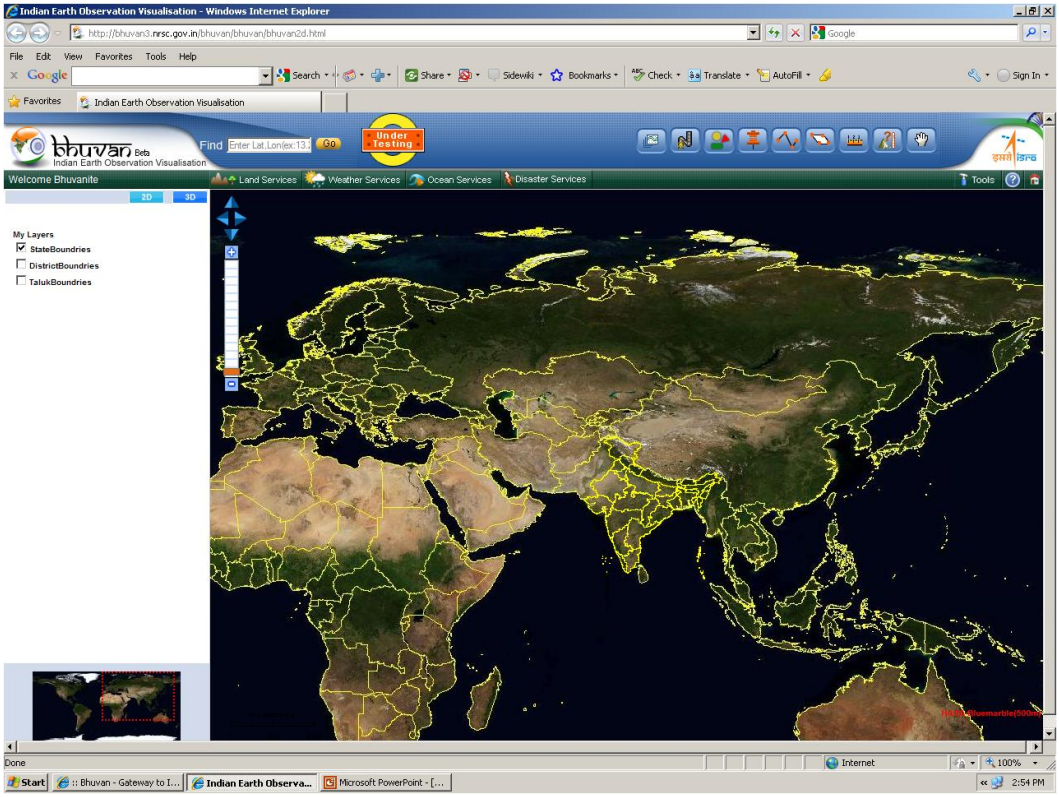
It is a free web based visualization system. By just logging on to www.bhuvan.nrsc.gov.in and downloading and installing the plug-in (only for first time use), users can access Bhuvan and can fly to locations around the world by either entering the names of places or the latitude, longitude coordinates.

Zooming in and out determines the number and kind of features or locations displayed as the resolution changes. As one zooms closer to a built-up area, for instance, smaller details and place names begin to appear automatically. On rendering, the thematic maps and their details are clickable, opening a pop-up window with information about its feature, links to related resources, photos, or other information. Users can change the orientation of the compass points of the map and adjust the aspect, such that the map is shown in any angle – from directly above to horizontal. For areas rendered in 3D, adjusting the aspect gives the impression of moving through a real space. Users can add 'Place-marks', which are clickable indicators of particular locations, and create 2D and 3D features, share, collaborative and chat use powerful urban design tools that is available on Bhuvan.

More than just images and maps, Bhuvan lets users create and share personal resources. In addition, the tool allows users to consume OGC complaint map services for viewing, query and analysis, on the fly. Browsing and exploring distant locales, augmented with contributions from other users, presents a compelling opportunity for discovery and learning. Contributing anecdotes, stories, and histories further allows users to communicate in a geographic context.

Bhuvan 2D (Beta)

The two dimensional (2D) Bhuvan, a web mapping service application based on Open Layers, open source project, offers powerful, user-friendly mapping technology to organize the satellite and map data along with myriad information geographically with no server-side dependencies in an easy way.

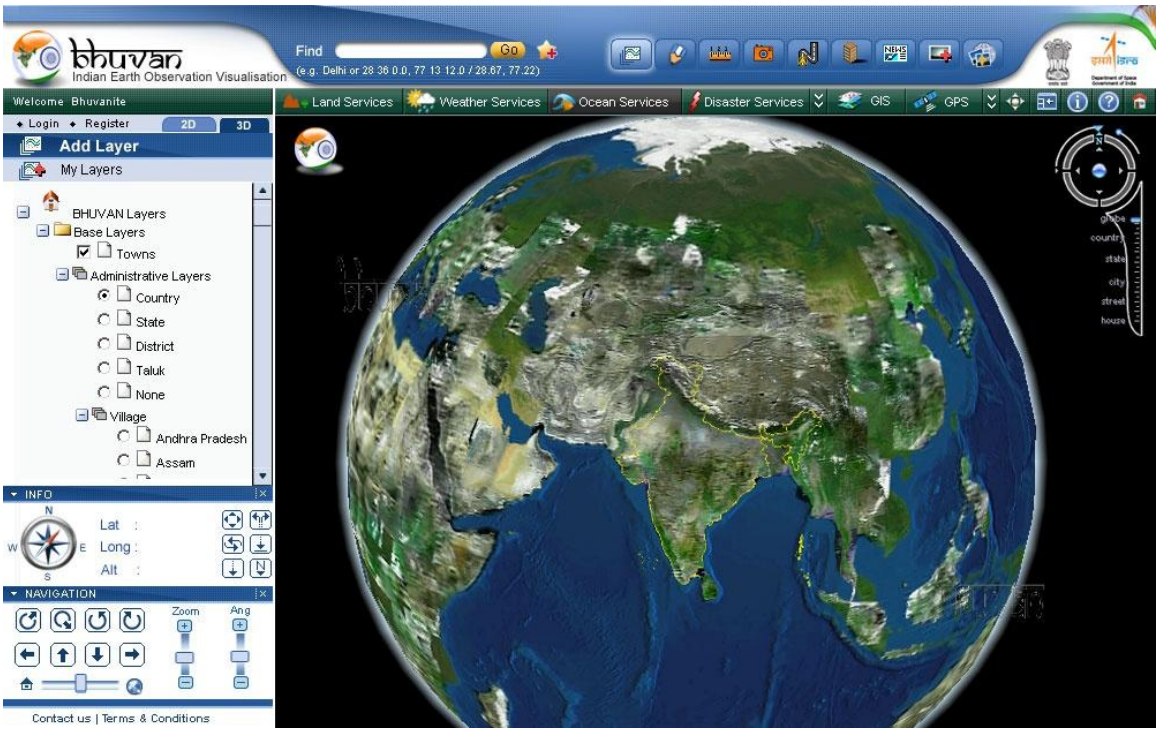


Bhuvan 2D is a slick, exciting on-line mapping application. It provides a highly responsive, intuitive mapping interface with detailed imagery and map data embedded. Some of its functional capabilities include map navigation, map panning, drawing line, point polygon, overview map, linear and areal measurement. These capabilities combine to make Bhuvan 2D a compelling product.

Bhuvan 3D

Bhuvan 3D showcases images in a Multi-sensor, Multiplatform and a Multi-temporal domain. It lets you access, explore and visualize IRS image and a bundle of rich thematic information in 3D landscape. On Bhuvan 3D, users can fly to different locations on the terrain and experience unparalleled 3D navigation.3D Bhuvan has many unique featured and easy to use intuitive interface, where user can virtually experience the physical

characteristics of the terrain, especially the Indian landscape. The urban design tools area magic galore. Here you can virtually build roads, junctions and traffic lights in an urban setting. Experience all this just on Bhuvan 3D.



Basic Features of Bhuvan

- Access, explore and visualize 2D and 3D image data along with rich value added services
- Visualize multi-resolution, multi-sensor, multi –temporal IRS image data
- Superpose administrative boundaries of choice on images as required up to village level.
- Visualization of AWS (Automatic Weather Stations) data/information in a graphic view and use tabular weather data of user choice
- Fly to locations (to fly from the current location directly to the selected location)
- Heads-Up Display (HUD) navigation controls (tilt slider, north indicator, opacity, compass ring, zoom slider)
- Navigation using the 3D view pop-up menu (fly-in, fly out, jump in, jump around, view point)
- 3D fly through (3D view to fly to locations, objects in the terrain, and navigate freely using the mouse or keyboard)
- Drawing 2D objects (text labels, polylines, polygons, rectangles, 2D arrows, circles, ellipse)
- Drawing 3D objects (placing of expressive 3D models, 2D polygons, boxes)
- Snapshot creation (copies the 3D view to a floating window and allows to save to an external file)
- Measurement tools (horizontal distance, aerial distance, vertical distance)
- Shadow analysis (it sets the sun position based on the given time creating shadows and effects the lighting on the terrain)
- Urban Design Tools (to build roads, junctions and traffic lights in an urban setting)
- Contour map (displays a colorized terrain map and contour lines)
- Terrain profile (displays the terrain elevation profile along a path)
- Draw tools (creates simple markers, free hand lines, urban designs)
- Navigation map (to jump to and view locations in the 3D India)
- Metadata for satellite images.